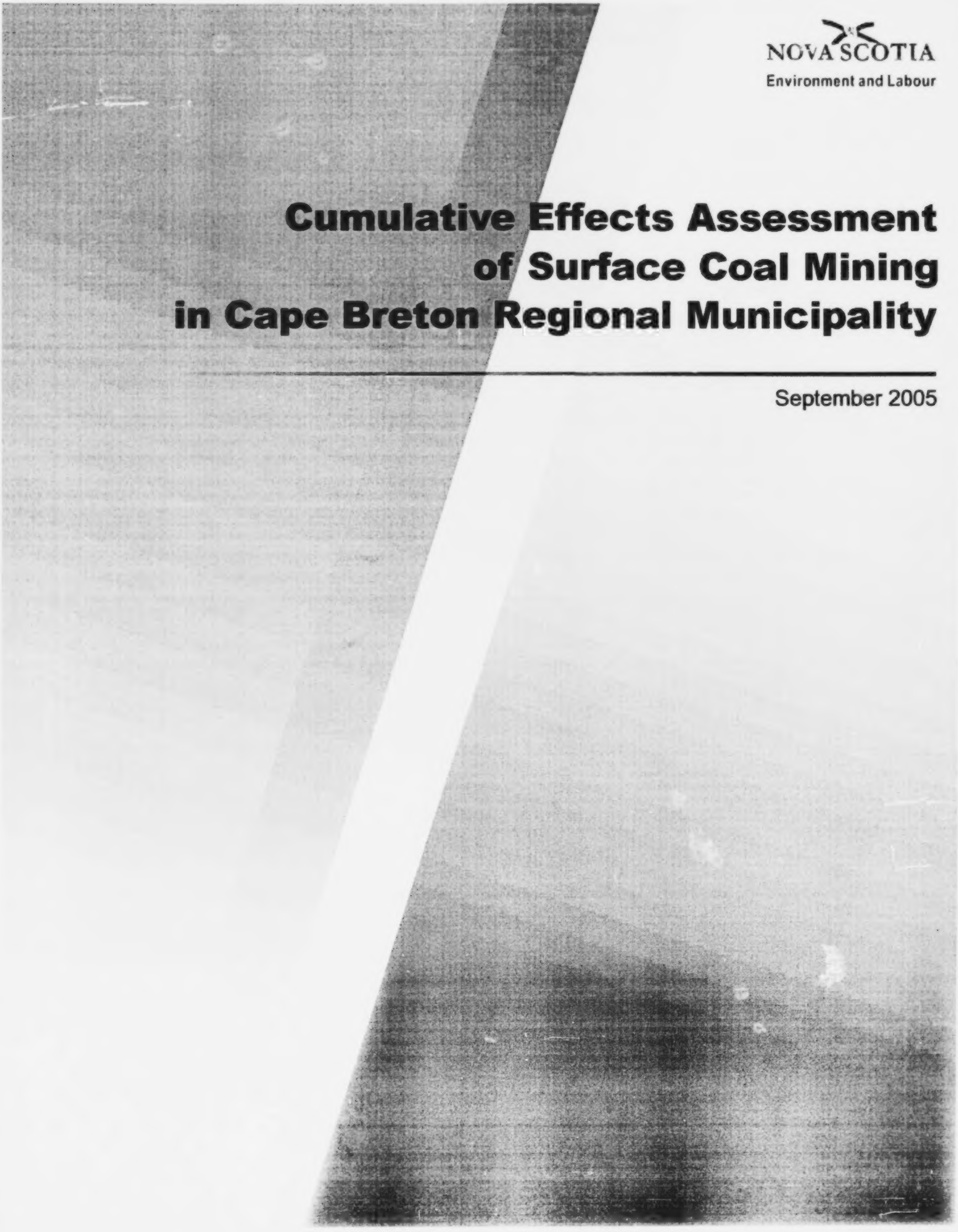


NOVA SCOTIA
Environment and Labour

Cumulative Effects Assessment of Surface Coal Mining in Cape Breton Regional Municipality

September 2005

FINAL REPORT

Cumulative Effects Assessment of Surface Coal Mining in Cape Breton Regional Municipality

NOVA SCOTIA ENVIRONMENT AND
LABOUR

PROJECT NO. NSD19669

106-04928/

PROJECT NO. NSD19669

PROJECT TO

Nova Scotia Environment and Labour
Environmental Assessment Branch
5151 Terminal Road, 5th Floor
Halifax, NS
B3J 2T8

ON

Cumulative Effects Assessment of Surface Coal Mining in Cape Breton Regional Municipality

---

September 2005

Jacques Whitford
3 Spectacle Lake Drive
Dartmouth, Nova Scotia,
B3B 1W8

Phone: 902-468-7777
Fax: 902-468-9009

www.jacqueswhitford.com

in association with

Griffiths Muecke Associates
5593-B Young Street
Halifax, NS B3K 1Z7

and

Pincock Allen & Holt
165 S. Union Blvd., Suite 950
Lakewood, Colorado 80228

EXECUTIVE SUMMARY

There has been a long history of coal mining in Cape Breton. Coal mining provides benefits, such as access to fuel, employment and business opportunities, and revenues for the Province. In some cases, there are also benefits resulting from reclamation of previously mined areas, if properly done. However, there is potential for adverse impacts including direct and cumulative environmental effects of mining operations, alteration of landscapes, and visual impacts. Recent proposals to commence surface mining operations in Cape Breton have generated concerns by individuals and community groups.

Nova Scotia Department of Environment and Labour (NSEL) has commissioned this study to investigate potential cumulative environmental effects of surface coal mining in the Cape Breton Regional Municipality (CBRM). The results of this study are intended to inform NSEL decision makers who are required to review applications for surface coal mining under the Nova Scotia *Environment Act* and Environmental Assessment Regulations. NSEL is concerned about the potential environmental effects of the proposed surface coal mining undertakings in conjunction with environmental effects of other past, present and likely future projects and activities (*i.e.*, cumulative environmental effects). Currently, Nova Scotia environmental legislation and guidelines offer little explicit consideration of cumulative effects in decision making.

The objective of this report is to study the cumulative environmental effects of surface coal mining in CBRM, with a focus on the Birch Grove, Broughton, Point Aconi and Boularderie Island resource blocks as identified by the Nova Scotia Department of Natural Resources (NSDNR) including:

- a consultation program which identifies key stakeholders in CBRM and solicits input on issues and concerns regarding potential surface coal mining development;
- mitigative measures and best management practices which can be used in Nova Scotia to reduce potential impacts from surface coal development; and
- a "generic" cumulative effects assessment based on readily available information concerning past, present and likely future projects and activities focussing on the four surface coal mining blocks.

This report is intended to provide useful information to NSEL decision makers to help with review of project-specific applications; it is not intended to make recommendations regarding the ultimate acceptability of surface coal mining in CBRM. It is the authors' opinion that only a project-specific application can provide the necessary level of detail required to determine the significance and ultimate acceptability of environmental effects (including cumulative effects) related to a proposed surface coal mining development in CBRM.

The report presents results from the public and stakeholder consultation program. Methodologies are included, as well as a summary of the information obtained during the consultation process.

Typical project activities and potential environmental interactions are outlined in the report. The project activities described include site preparation, coal extraction and reclamation. Potential environmental interactions with each of the Project activities are also presented.

Mitigation measures and best management practices are discussed. These measures and practices are presented in consideration of common practices in Nova Scotia, as well as other Canadian jurisdictions and the United States.

The report includes a generalized cumulative effects assessment. The methodology, scope and selection of Valued Environmental Components (VECs), as well as development assumptions are presented. Assessments are presented for the following VECs:

- Atmospheric Environment;
- Terrestrial Environment;
- Fish and Fish Habitat;
- Water Resources;
- Land Use;
- Transportation Infrastructure;
- Human Health and Public Safety; and
- Labour and Economy.

Summary of Results

Public and stakeholder consultation was carried out within CBRM to identify issues of concern. Concerns identified include:

- Industry competence with regard to environmental management;
- Government's willingness to consult the public;
- Government's capacity to monitor and regulate the surface coal mining industry;
- The effectiveness of best management practices to avoid environmental impacts and achieve high standards of site reclamation; and
- The concept of reclamation mining as a beneficial way to remove public hazards.

Mitigative measures and best management practices were identified from Nova Scotia, other Canadian jurisdictions and the United States. These practices covered a wide range of potential environmental and socio-economic issues related to surface coal mining including management of air and water emissions and site reclamation. Best management practices are described in the report which provides an important opportunity for NSEL to enhance environmental management for proposed surface coal mining projects.

The cumulative effects assessment concluded that surface coal mining will create a number of adverse effects on valued environmental and socio-economic components, and that these effects will potentially interact with other past, present and future projects and activities to create cumulative effects on those components. However, on a project by project basis these effects many not be significant, or could potentially be mitigated to insignificant levels.

Cumulative adverse effects are likely on: atmospheric environment; water supply; terrestrial environment; and fish and fish habitat. A number of potential environmental effects from surface coal mining are expected to be relatively limited in spatial extent which would tend to localize cumulative effects. Standard mitigative measures, if carefully applied and strictly enforced, would likely be effective in reducing offsite impacts from a number of mining activities and thus the potential for cumulative effects. Application of best management practices would further limit the potential for offsite impacts and cumulative effects. In particular, effective mitigation would include avoidance of sensitive habitats, occurrences of rare species, and areas of high water resource use as a priority during mine planning.

Proper reclamation of surface coal mining sites using best management practices is considered essential to the overall acceptability of the industry and reduction of long-term cumulative environmental effects. It is anticipated that some positive cumulative ecosystem effects could occur if reclamation mining restores habitat and/or reduces harmful discharges at sites that are currently degraded from previous industrial activities.

There will likely be cumulative adverse effects on land use if all four resource blocks were to be developed over the next few years in conjunction with previously impacted lands in the area. These adverse effects include impacts to visual aesthetics, amenity services (*e.g.*, recreation), and an alteration of the perceived characteristics of the affected areas. Some effects would be of limited duration, spanning the life of a project and some effects are amenable to mitigation and best management practices. Significant adverse cumulative effects are possible however, particularly if coal mining contributes to a negative image of Cape Breton and local communities. There is potential for a positive effect on public safety if surface coal mining operations successfully remove hazardous openings and past mining undertakings. The extent of this positive effect, especially weighed against alternative approaches and other effects of surface coal mining requires further study. There are likely to be minor cumulative effects (benefits) on labour and economy from mining activity. Additional benefit can also include avoided cost of government sponsored reclamation.

In summary, mitigative measures and best management practices are available to potentially reduce cumulative impacts from surface coal development to non-significant levels for the valued environmental and socio-economic components assessed (assuming strict compliance and monitoring). However, there remains the potential for significant adverse effects to occur based on the specific characteristics of each project site and according to each project design. A definitive assessment of the significance of residual cumulative effects can only occur in the context of project specific environmental assessment. Project specific assessment must also be supported by a thorough monitoring program and strict enforcement of environmental protection measures by proponents and government.

Recommendations are made in the report for consideration by the government agencies involved in decision making with respect to surface coal mining in CBRM and throughout Nova Scotia; these include:

- Adoption of Best Management Practices;
- Reclamation planning;
- Community consultation and involvement; and
- Assessment of cumulative effects in project-specific environmental assessment.

Table of Contents

EXECUTIVE SUMMARY i

Cumulative Effect Assessment of Surface Coal Mining in Cape Breton Regional Municipality 1

1.0 INTRODUCTION 1
1.1 Study Overview and Objectives 1
1.2 Study Background 2
1.3 Regulatory Framework 9
1.3.1 Exploration Activities 9
1.3.2 Mine Development 9
1.3.3 One Window Process 10
1.3.4 Joint Federal-Provincial Process 10
1.4 Study Limitations 11
1.5 Organization of the Report 11

2.0 PUBLIC/STAKEHOLDER CONSULTATION PROGRAM 13
2.1 Methodology 13
2.2 Results 13
2.3 Summary 29

3.0 TYPICAL PROJECT ACTIVITIES AND POTENTIAL ENVIRONMENTAL INTERACTIONS 32
3.1 Project Activities 32
3.1.1 Site Preparation 32
3.1.2 Coal Extraction and Transportation 33
3.1.3 Reclamation 34
3.2 Potential Environmental Interactions 35

4.0 MITIGATIVE MEASURES AND BEST MANAGEMENT PRACTICES 38
4.1 Mitigative Measures and Management Practices in Nova Scotia. 38
4.2 Other Jurisdictions 40
4.2.1 Canadian Jurisdictions 40
4.2.2 United States 41

5.0 CUMULATIVE EFFECTS ASSESSMENT 49
5.1 Methodology 49
5.2 Scope and VEC Selection 51
5.2.1 VEC Identification 51
5.2.2 Spatial and Temporal Boundaries 53
5.2.3 Existing Conditions 57
5.2.4 Residual Environmental Effects Evaluation Criteria 57
5.2.5 Effects Assessment and Mitigation 58
5.3 Development Assumptions 58
5.3.1 Tendered Resource Blocks 59
5.3.2 Surface Coal Mine Developments Outside of the Tendered Resource Blocks 63

5.4 Biophysical Assessment 64
5.4.1 Atmospheric Environment 64
5.4.1.1 Air Quality 64
5.4.1.2 Noise 70
5.4.1.3 Residual Cumulative Effects 71
5.4.2 Terrestrial Environment 71
5.4.2.1 Overview of Existing Conditions 71
5.4.2.2 Effects Assessments and Mitigation 81
5.4.2.3 Residual Effects Summary 88
5.4.3 Fish and Fish Habitat 88
5.4.3.1 Overview of Existing Environment 88
5.4.3.2 Effects Assessment and Mitigation 93
5.4.3.3 Summary of Cumulative Effects 100
5.4.4 Water Resources 101
5.4.4.1 Overview of Existing Conditions 101
5.4.4.2 Effects Assessment and Mitigation 110
5.4.4.3 Summary of Residual Cumulative Effects 115
5.5 Socio-economic Assessment 116
5.5.1 Land Use 116
5.5.1.1 Overview of Existing Conditions 117
5.5.1.2 Effects Assessment and Mitigation 119
5.5.1.3 Cumulative Effects Summary 119
5.5.2 Transportation Infrastructure 120
5.5.2.1 Overview of Existing Conditions 120
5.5.2.2 Effects Assessment and Mitigation 121
5.5.2.3 Summary of Cumulative Effects 122
5.5.3 Human Health and Public Safety 122
5.5.3.1 Overview of Existing Conditions 123
5.5.3.2 Effect Assessment and Mitigation 123
5.5.3.3 Cumulative Effects Summary 123
5.5.4 Labour and Economy 124
5.5.4.1 Overview of Existing Conditions 124
5.5.4.2 Effects Assessment and Mitigation 125
5.5.4.3 Cumulative Effects Summary 125
5.6 Summary of Cumulative Effects 126

6.0 CONCLUSIONS AND RECOMMENDATIONS 132
6.1 Conclusions 132
6.2 Recommendations 133

7.0 REFERENCES 135
7.1 Literature Cited 135
7.2 References for Best Management Practices 139
7.3 Personal Communication 140

List of Tables

TABLE 2.1 Summary of Issues Identified in the Public Consultations and Concordance to the Report 29
TABLE 3.1 Potential Interactions Between Project Activities and Environmental Components 36
TABLE 4.1 Summary of Standard Mitigative Measures and Management Practices Applied in Nova Scotia 38
TABLE 4.2 Summary of Best Management Practices for Surface Coal Mining 43
TABLE 5.1 Project Activities Considered for Potential Environmental Interactions with Surface Coal Mining 51
TABLE 5.2 Scoping of VECs 52
TABLE 5.3 Assessment Boundaries and Significance Criteria 54
TABLE 5.4 NOVA SCOTIA Air Quality Regulations and *Canadian Environmental Protection Act* Ambient Air Quality Objectives 67
TABLE 5.5 Well Characteristics in Upper and Lower Morien 104
TABLE 5.6 Summary of Residual Cumulative Environmental Effects and Follow-up 127

List of Figures

FIGURE 1.1 Project Study Area Cape Breaton Regional Municipality . 3
FIGURE 1.2A Point Coni and Boularderie Island Surface Coal Resource Blocks Regional Road network and Communities 4
FIGURE 1.2B Birch Grove and Broughton Surface Coal Resource Blocks Regional Road Network and Communities 5
FIGURE 1.3A Point Aconi and Boularderie Island Surface Coal Resource Blocks Mineral Resources 7
FIGURE 1.3B Birch Gove and Broughton Surface Coal Resources Blocks Mineral Resources 8
FIGURE 5.1 Potential Future Surface Coal Mine Operations 60
FIGURE 5.2 Average Wind Conditions Sydney Area 65
FIGURE 5.3A Point Aconi and Boularderie Island Surface Coal Resource Blocks Forest Classification 72
FIGURE 5.3B Birch Grove and Broughton Surface Coal Resource Blocks Forest Classification 73
FIGURE 5.4A Point Aconi and Boularderie Island Surface Coal Resource Blocks Land Classification 74
FIGURE 5.4B Birch Grove and Broughton Surface Coal Resource Blocks Land Classification 75
FIGURE 5.5A Point Aconi and Boularderie Island Surface Coal Resource Blocks Significant Habitats 76
FIGURE 5.5B Birch Grove and Broughton Surface Coal Resource Blocks Significant Habitats 77
FIGURE 5.6A Point Aconi and Boularderie Island Surface Coal Resource Blocks Surface Water Resources 89

FIGURE 5.6B Birch Grove and Broughton Surface Coal Resource Blocks Surface Water Resources 92
FIGURE 5.7A Point Aconi and Boularderie Island Surface Coal Resource Blocks Geology.. 102
FIGURE 5.7B Birch Grove and Broughton Surface Coal Resource Blocks Geology 103

List of Appendices

APPENDIX A Aerial Photos of Coal Resource Blocks (Figures 1 to 4)
APPENDIX B Regulatory Process for Mine Exploration and Development
APPENDIX C List of Contacts
APPENDIX D Supplemental Information From Community Consultation
APPENDIX E Vegetation Assessment of Surface Coal Mine Reclamation Sites

CUMULATIVE EFFECT ASSESSMENT OF SURFACE COAL MINING IN CAPE BRETON REGIONAL MUNICIPALITY

1.0 INTRODUCTION

Nova Scotia Department of Environment and Labour (NSEL) has commissioned a study to investigate potential cumulative environmental effects of surface coal mining in the Cape Breton Regional Municipality (CBRM). The results of this study are intended to inform NSEL decision makers who are required to review applications for surface coal mining under the Nova Scotia *Environment Act* and Environmental Assessment Regulations. These decision makers are concerned about the potential environmental effects of the proposed surface coal mining undertakings such that they have requested that these undertakings be reviewed in consideration of environmental effects of other past, present and likely future projects and activities (*i.e.*, cumulative environmental effects). Nova Scotia environmental legislation and guidelines currently offers little guidance to Proponents with respect to conducting cumulative effects assessment.

1.1 Study Overview and Objectives

There has been a long history of coal mining in Cape Breton. Coal mining provides benefits, such as access to fuel, employment and business opportunities, and revenues for the Province. In some cases, there are also benefits resulting from reclamation of previously mined areas. For example, some of the areas under consideration have been subject to past mining either by authorized operators or by illegal "bootleg" mining, typically as near surface underground mining. The presence of this type of mining has led to structurally unstable land, including hazardous mine openings, and restricted land use. Thus, the removal of hazardous mine openings and stabilization of undermined areas as part of reclamation efforts associated with new surface mining activities is considered by some to be a benefit.

However, there is potential for adverse impacts including immediate and cumulative environmental effects of mining operations, alteration of landscapes, and visual impacts. Recent proposals to commence surface mining operations in Cape Breton have generated concerns by individuals and community groups. In light of the potential adverse impacts, NSEL wishes to investigate potential cumulative environmental effects of surface coal mining and to seek recommendations to address these concerns.

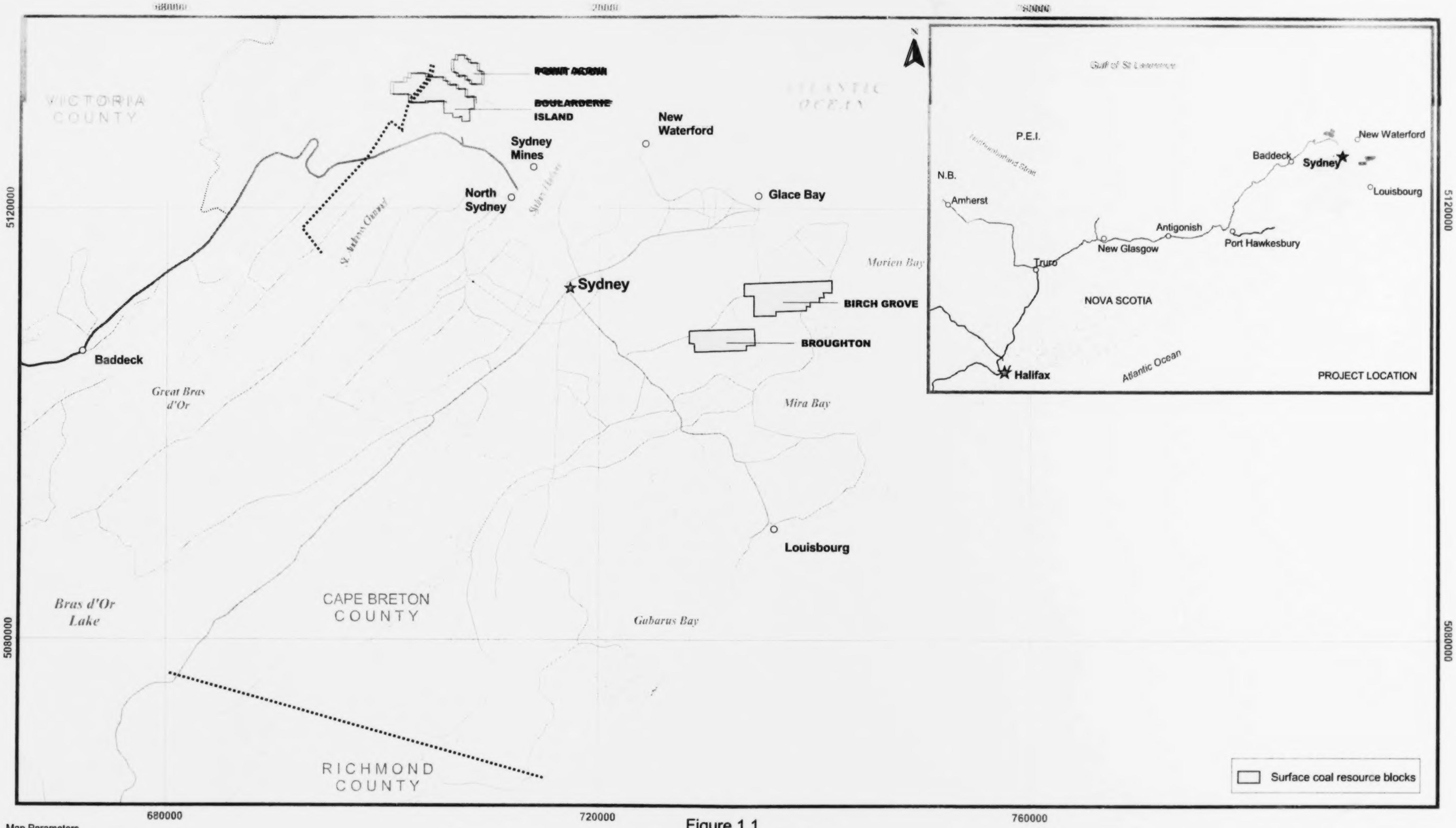
The objective of this work is to study the cumulative environmental effects of surface coal mining in CBRM, with a focus on the Birch Grove, Broughton, Point Aconi and Boularderie Island resource blocks as identified by the Nova Scotia Department of Natural Resources (NSDNR) (Figures 1.1, 1.2A, and 1.2B). This study includes:

- a consultation program which identifies key stakeholders in CBRM and solicits input on issues and concerns regarding potential surface coal mining development;
- mitigative measures and best management practices which can be used in Nova Scotia to reduce potential impacts from surface coal development; and
- a "generic" cumulative effects assessment based on readily available information concerning past, present and likely future projects and activities focussing on the four surface coal mining blocks.

1.2 Study Background

Coal has played a significant role in the history of Nova Scotia, particularly Cape Breton. While the coal mining industry has seen substantial reduction in activity in recent years, coal nonetheless continues to play a role in the provincial economy. For example, coal is a significant fuel source used in power generation in the Province, much of which is currently imported. The importance of coal is highlighted in NSDNR (1996), Nova Scotia's Mineral Policy and Nova Scotia Department of Energy (2001), Nova Scotia's Energy Strategy which commit the Province to supporting coal mining when it is financially feasible and environmentally sustainable.

During early European settlement, French explorers initially began small scale coal mining in the late 1600s, but by 1720, the first commercial coal mine in Canada had opened in Cape Breton (Cape Breton Coal 2004). In the years since, a variety of coal fields have been discovered and mined in Cape Breton to fuel the industrial and economic growth of the Province. The most prominent of the coal fields is the Sydney coal field. Until recently, the Cape Breton Development Corporation (CBDC) held a coal mineral lease over the entire Sydney coal field and was responsible for its development (NSDNR 2005). CBDC ceased mining operations in 2001 and the mineral lease was surrendered to the Province of Nova Scotia in 2003 (NSDNR 2005).



680000
720000
760000
5120000
5080000
POINT ACONI
BOULARDERIE ISLAND
VICTORIA COUNTY
ATLANTIC OCEAN
New Waterford
Sydney Mines
North Sydney
Glace Bay
Sydney
St. Andrews Channel
Sydney Harbour
Morien Bay
BIRCH GROVE
BROUGHTON
Baddeck
Great Bras d'Or
Mira Bay
Louisbourg
Bras d'Or Lake
CAPE BRETON COUNTY
Gabarus Bay
RICHMOND COUNTY
N
Gulf of St Lawrence
P.E.I.
Northumberland Strait
N.B.
Amherst
Truro
New Glasgow
Antigonish
Port Hawkesbury
NOVA SCOTIA
Halifax
Atlantic Ocean
Baddeck
Sydney
New Waterford
Louisbourg
PROJECT LOCATION
Surface coal resource blocks

Figure 1.1

Project Study Area
Cape Breton Regional Municipality

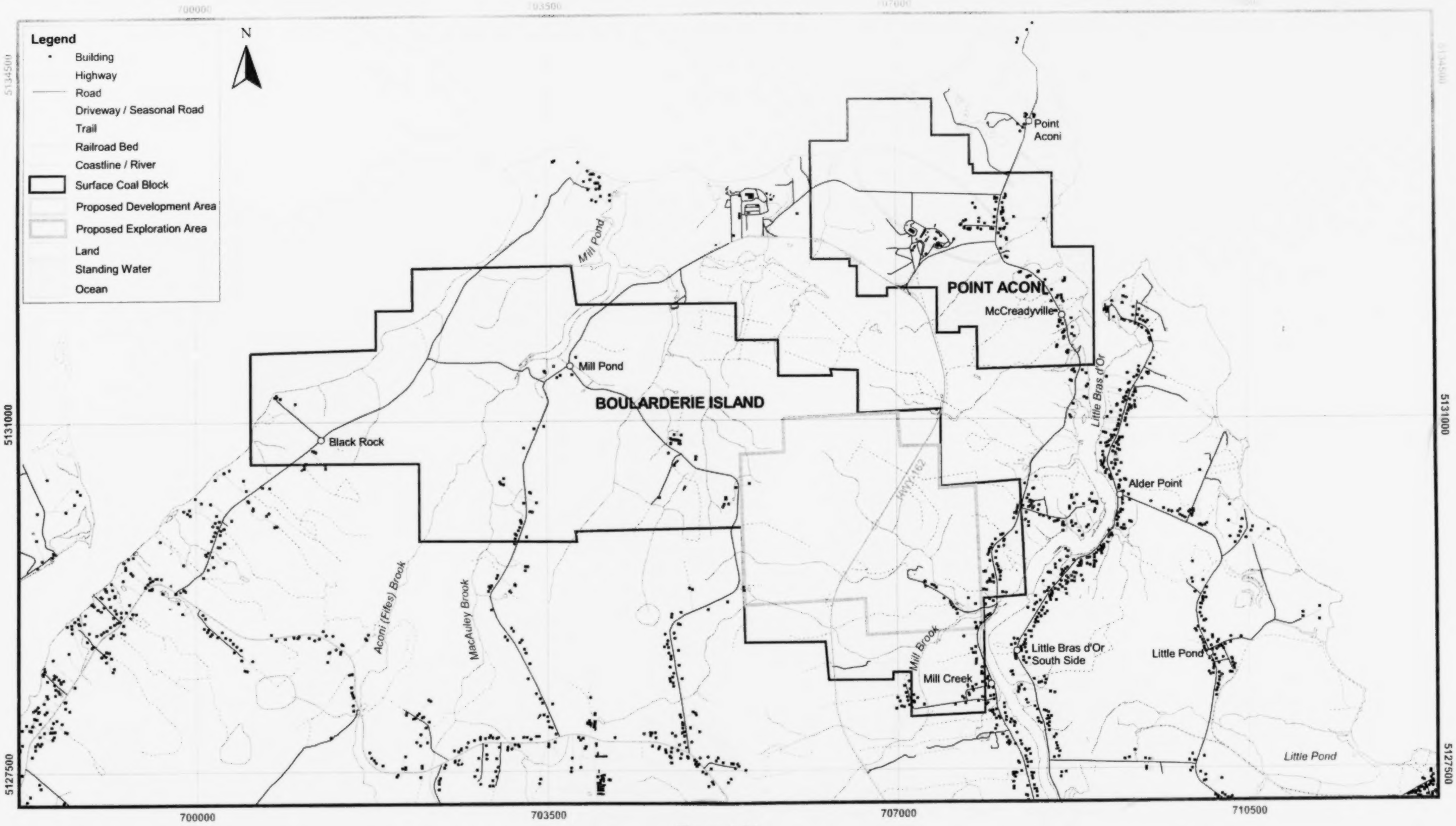
10 0 10 20 30
Kilometers

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:325,000
Project No.: NSD19669
Date: July 28, 2005

Data Source:
NSTS, 1997, scale 1:10 000
NSGC, Road Atlas, 1:500 000

NOVA SCOTIA
Environment and Labour

Jacques Whitford


700000
703500
707000
5134500
5131000
5127500
Legend
• Building
Highway
Road
Driveway / Seasonal Road
Trail
Railroad Bed
Coastline / River
Surface Coal Block
Proposed Development Area
Proposed Exploration Area
Land
Standing Water
Ocean
N
Point Aconi
Mill Pond
POINT ACONI
McCreadyville
Mill Pond
BOULARDERIE ISLAND
Black Rock
Little Bras d'Or
HWY-162
Alder Point
Aconi (Fifes) Brook
MacAuley Brook
Mill Brook
Mill Creek
Little Bras d'Or South Side
Little Pond
Little Pond
700000
703500
707000
710500

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NSTS, 1997, scale 1:10 000

Figure 1.2A

Point Aconi and Boularderie Island Surface Coal Resource Blocks
Regional Road Network and Communities

1 0 1 2 3 4
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford

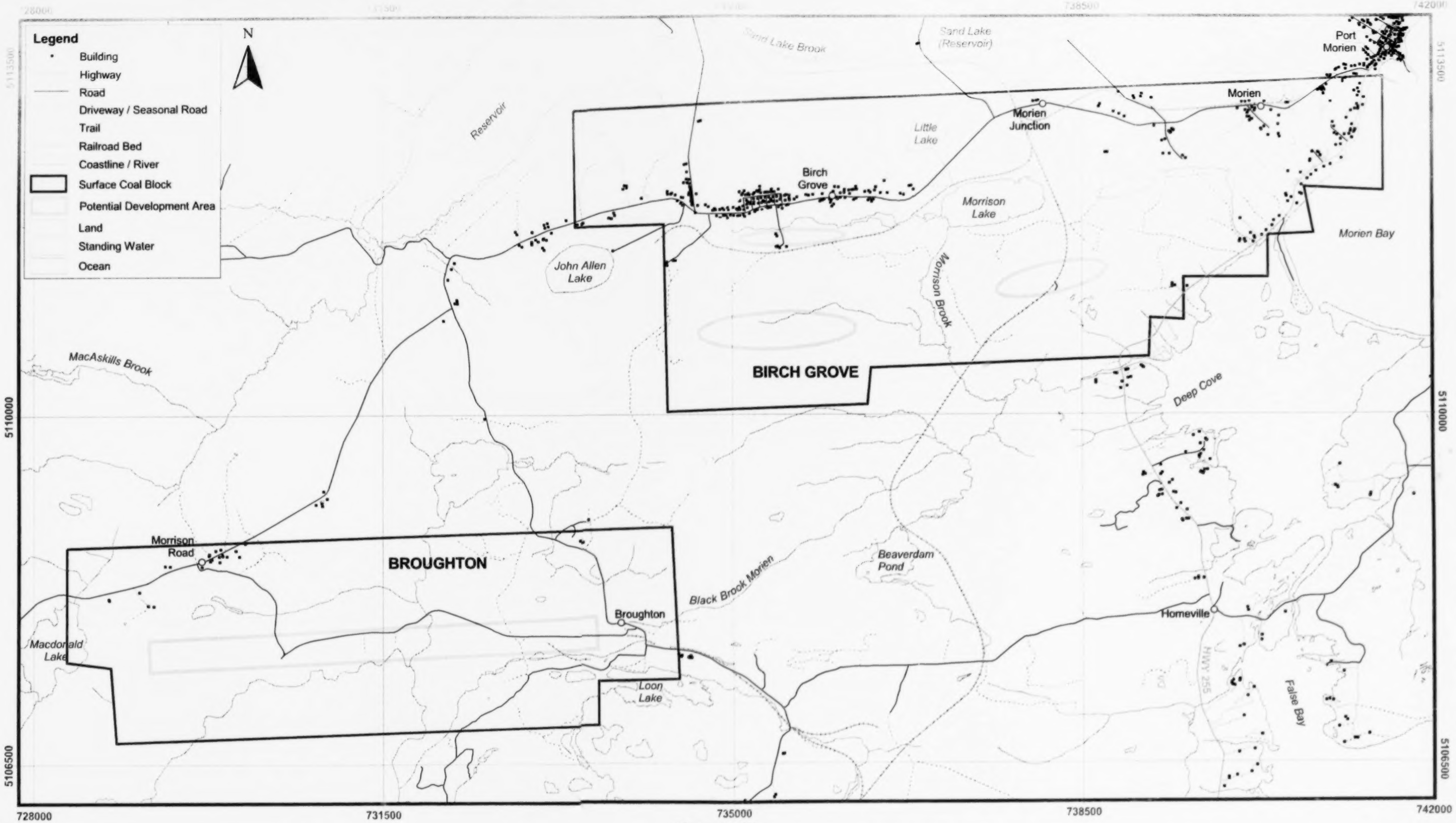

Legend
Building
Highway
Road
Driveway / Seasonal Road
Trail
Railroad Bed
Coastline / River
Surface Coal Block
Potential Development Area
Land
Standing Water
Ocean
N
728000
731500
735000
738500
742000
5113500
5110000
5106500
Reservoir
Sand Lake Brook
Sand Lake (Reservoir)
Port Morien
Morien
Morien Junction
Little Lake
Birch Grove
Morrison Lake
Morien Bay
John Allen Lake
Morrison Brook
BIRCH GROVE
MacAskills Brook
Deep Cove
Morrison Road
BROUGHTON
Beaverdam Pond
Black Brook Morien
Broughton
Homeville
Macdonald Lake
Loon Lake
HWY 255
False Bay

Figure 1.2B

Birch Grove and Broughton Surface Coal Resource Blocks
Regional Road Network and Communities

1 0 1 2 3 4
Kilometers

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NSTS, 1997, scale 1:10 000

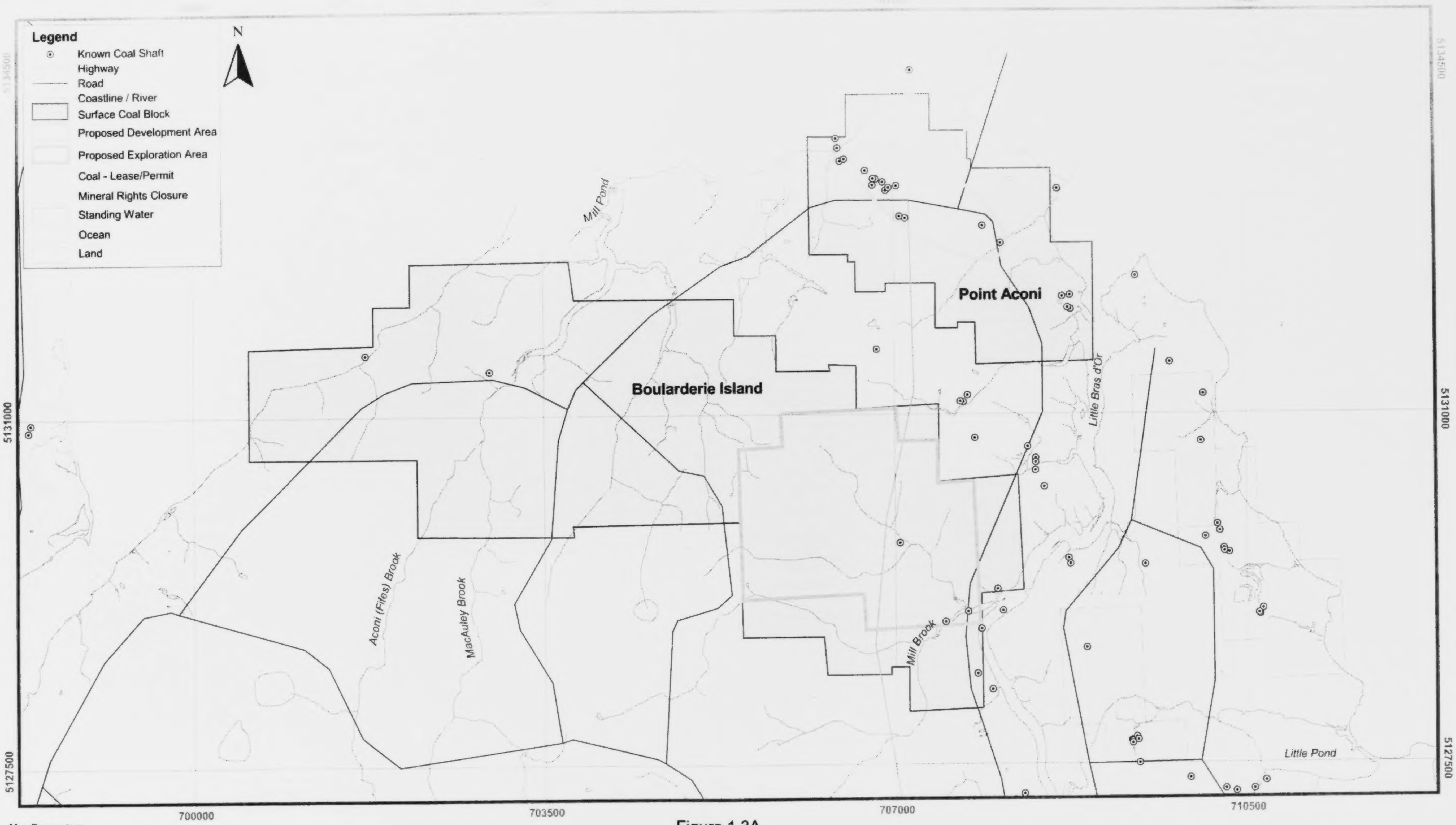
NOVA SCOTIA
Environment and Labour

Jacques Whitford

Compared to underground mining, surface coal mining has a much shorter history in CBRM, beginning with the Mills Mining project at Little Pond in 1947 and resuming in 1973 at Alder Point with a mining operation initiated by the Cape Breton Development Corporation (CBDC) during a strike situation in the underground mines. Most of the surface mines (eight in all) have been developed on the North Side, on the northern end of Boularderie Island and in the Florence/Alder Point area. On the South Side, a large surface mine operated near Reserve Mines from 1986 to 1992, and a bulk sample operation, as yet unreclaimed, took place in the Broughton area a few years ago. In addition to CBDC mining, many areas of the coal field have been historically mined either by authorized operators or by illegal "bootleg" mining. Some of the past mining activities that have occurred in the resource blocks are shown in Figures 1.3A and 1.3B. Due to the covert nature of bootleg mining operations, the location and extent of the bootleg workings were unreported and rarely documented. While most bootleg workings have been discovered only few have been surveyed. Because bootleg mining was typically conducted near surface, many areas may contain hazardous mine openings or be structurally unstable, thereby limiting current land use opportunities.

In 2003, NSDNR reviewed its prior assessment of the coal field and issued a call for proposals from interested proponents for the exploration, development and reclamation of selected areas of the coal field. Recent award of mineral rights by the Province to explore, develop and reclaim selected areas of the Sydney coal field highlights the continued importance of coal to the Province. Proponents have submitted proposals to develop some parts of these blocks. Coal seams and potential development areas within these blocks are shown in Appendix A (Figures 1 to 4).

Pioneer Coal Limited has registered an environmental assessment (EA) to develop the former Prince Mine site in the Point Aconi block which is currently being reviewed by the Province. Coastal Construction and Excavating Limited have been awarded an exploration license in the Boularderie Island block. An application by Thomas Brogan and Sons Construction Limited under the *Mineral Resources Act* in the Birch Grove block was rejected by the Province. Pioneer Coal Ltd. has submitted an application for a mineral lease in the Broughton block.


Legend
Known Coal Shaft
Highway
Road
Coastline / River
Surface Coal Block
Proposed Development Area
Proposed Exploration Area
Coal - Lease/Permit
Mineral Rights Closure
Standing Water
Ocean
Land
N
Mill Pond
Point Aconi
Boularderie Island
Little Bras d'Or
Aconi (Fifes) Brook
MacAuley Brook
Mill Brook
Little Pond
5134500
5131000
5127500
700000
703500
707000
710500

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS DNR Mineral Rights Database,
2003, scale 1:500 000

Figure 1.3A

Point Aconi and Boularderie Island Surface Coal Resource Blocks
Mineral Resources

1 0 1 2 3 4
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford

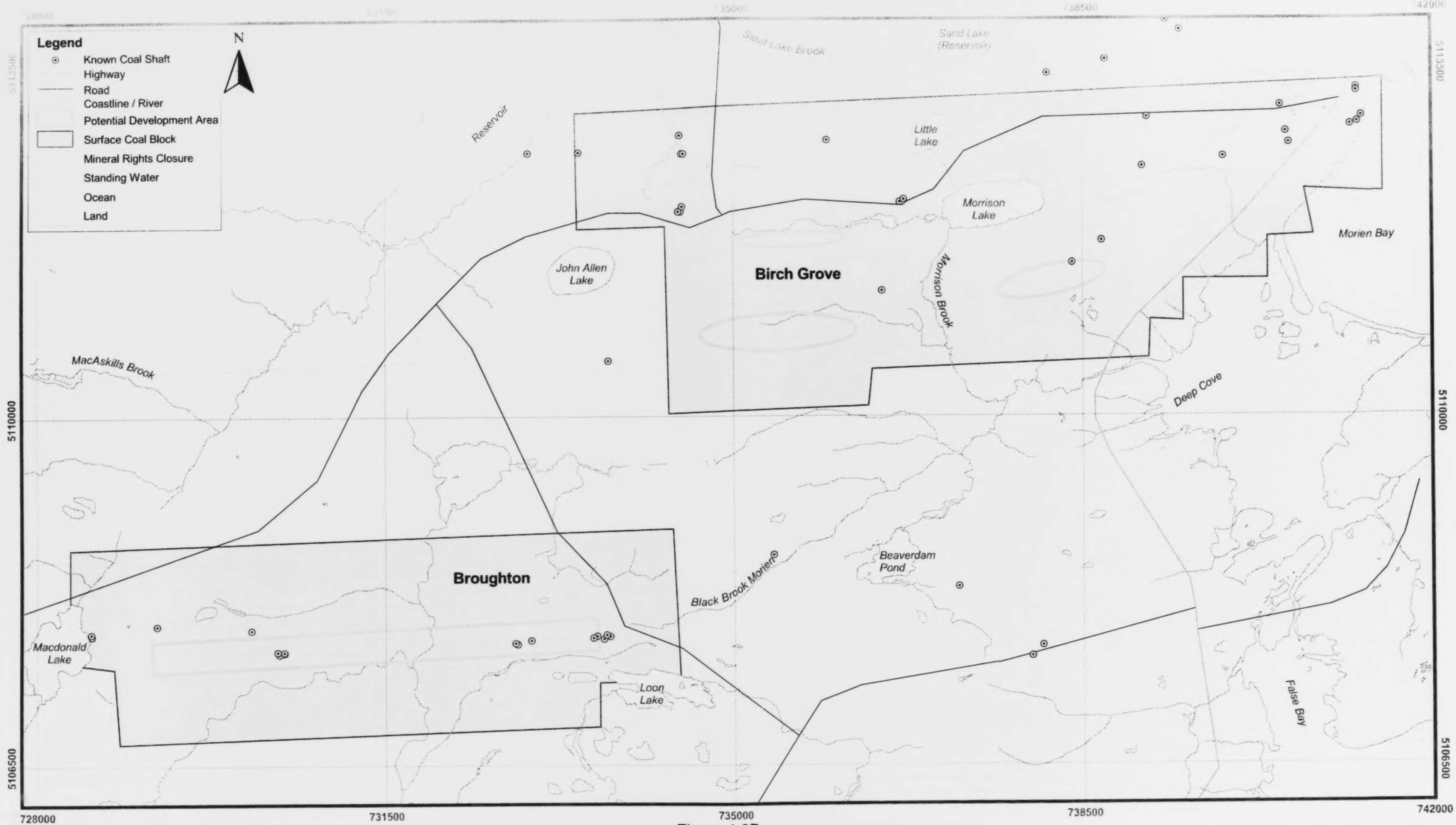

Legend
Known Coal Shaft
Highway
Road
Coastline / River
Potential Development Area
Surface Coal Block
Mineral Rights Closure
Standing Water
Ocean
Land
N
Sand Lake Brook
Sand Lake (Reservoir)
Reservoir
Little Lake
Morrison Lake
Morien Bay
John Allen Lake
Birch Grove
Morrison Brook
MacAskills Brook
Deep Cove
Beaverdam Pond
Broughton
Black Brook Morien
Macdonald Lake
Loon Lake
False Bay
728000
731500
735000
738500
742000
5113500
5110000
5106500

Figure 1.3B

Birch Grove and Broughton Surface Coal Resource Blocks Mineral Resources

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS DNR Mineral Rights Database,
2003, scale 1:500 000

1 0 1 2 3 4
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford

1.3 Regulatory Framework

Mining activity in Nova Scotia is regulated under various statutes and regulations and administered by several government departments. Depending on the nature of the activity (*i.e.*, exploration or development), different permits and approvals are required from NSEL and/or NSDNR. Regardless of the nature of the activity to be undertaken, landowner approval/consent is required and all activities are subject to inspection by representatives of NSEL.

Permits and approvals required for various mining activities are described below and presented in Appendix B.

1.3.1 Exploration Activities

There are a number of exploration type activities that require some form of approval from NSDNR. NSDNR permits and approvals are issued under the authority of the *Mineral Resources Act*. In order for a proponent to undertake non-intrusive activities such as prospecting, sampling (*e.g.*, geochemical, outcrop), and geophysical testing, an Exploration License (also referred to as a Special License when it pertains to coal, salt, potash, and uranium) is issued by NSDNR. This license grants the exclusive right to search and prospect for minerals within a designated area.

More intrusive activities such as diamond drilling and trenching and sampling require notification, as well as the license. A proponent undertaking diamond drilling must complete a Drill Notification and submit it to NSDNR. Processing of this information includes notification of NSEL. Trenching alone (*i.e.*, with no sampling) requires an Excavation Registration from NSDNR who notifies NSEL. Bulk sampling also requires an Excavation Registration from NSDNR as well as additional permits from NSDNR and NSEL, depending on the size of the sample. Bulk samples less than 100 tonnes are subject to review by NSEL to identify potential requirements for EA and Industrial Approval. Bulk samples greater than 100 tonnes require a Letter of Authority from NSDNR, an Industrial Approval from NSEL, and are subject to review for a potential EA.

1.3.2 Mine Development

Mine development projects require other permits and approvals from NSDNR and NSEL. Typically, a proponent proposing a mine development will first obtain a Mineral Lease (also known as a Special Lease when it pertains to coal, salt, potash, and uranium) from NSDNR. The Lease provides exclusive entitlement to extract minerals from a defined area. Once the lease is granted, the proponent must then register the proposed mine development project as a Class I Undertaking (*i.e.*, a facility engaged in the extraction or processing of metallic and non-metallic minerals, coal, peat moss, gypsum, limestone, bituminous shale or oil shale). To facilitate preparation of an EA registration document of a proposed project, NSEL has prepared a guidance document entitled "Guide to Preparing an EA Registration Document for Mine Developments in Nova Scotia" (NSEL 2002).

Once filed, an EA registration document is made available to the public for review and comment. This registration and review process also allows for input by various municipal, provincial, and federal government agencies. The Minister of Environment and Labour considers public and agency comments when preparing a decision on the project.

Upon approval of a project by the Minister of Environment and Labour, the proponent must then apply for an Industrial Approval in accordance with the Activities Designation Regulations. Depending on the details of the project, other approvals may be required such as a Water Approval and an approval to construct and operate sewage works or a sewage system.

An approved EA and Industrial Approval are typically issued with Terms and Conditions which govern how the project will be developed, operate and be reclaimed, as well as dictating the ongoing environmental monitoring requirements (*e.g.*, particulate, noise, surface water quality, etc.).

1.3.3 One Window Process

Given the various requirements for permits and approvals for mine developments in Nova Scotia, the government has developed a "one window" process for review, permitting, and monitoring these types of developments. The process was put in place to ensure the activities of government departments involved are coordinated, and to facilitate an informed, timely and consistent review.

The government agencies at the forefront of the one window process are NSDNR and NSEL. Other provincial and federal departments may become involved, depending on the details of the development.

1.3.4 Joint Federal-Provincial Process

As indicated above, some projects may require approvals or authorizations from government agencies other than NSDNR and NSEL. Depending on the details of the proposed development, a federal EA under the *Canadian Environmental Assessment Act (CEAA)* may be required. In such instances, a joint federal-provincial EA is required. Preparation of the assessment is facilitated through the one window process and the Canadian Environmental Assessment Agency (CEA Agency). Often, a federal-provincial agreement on the joint process is prepared to further ensure a coordinated effort and review of the proposed development.

An example of the above is a project which may result in the requirement for an authorization to harmfully alter, disrupt or destroy fish or fish habitat as determined by Fisheries and Oceans Canada. Such an authorization (Section 35 of the federal *Fisheries Act*) triggers the requirement for an EA under *CEAA*.

1.4 Study Limitations

This study was developed within the limitations of the scope and budget provided by NSEL. The scope is broad, covering a large area of CBRM including an assessment of potential cumulative environmental effects resulting from, in some cases, hypothetical future surface coal mining activities. The study team was limited to incorporation of readily and pubically available information on existing environmental conditions and potential development scenarios as well as the advice of NSDNR and NSEL, and professional knowledge of the study team.

The study team has used its best professional judgment to develop the assessment and accurately portray the results. However, the cumulative effects assessment in this document is general by necessity, and there is the potential for locally significant effects to be generalized. Environmental impact assessment, as it is most commonly practiced, is a relatively site-specific and project-specific environmental planning exercise where specific environmental interactions can be quantified and specific mitigation and follow-up programs designed. A better understanding of potential cumulative effects can therefore result from project-specific environmental assessment. It is a fundamental assumption of this study that project-specific assessments will be undertaken under the appropriate provincial process and, if required, federal process, whereupon a more precise understanding of cumulative effects can be determined.

This report is intended to provide useful information to NSEL decision makers to help with policy development and the review of project-specific applications; it is not intended to make recommendations regarding the ultimate acceptability of surface coal mining in CBRM. It is the authors' opinion that only a project-specific application can provide the necessary level of detail required to determine the significance and ultimate acceptability of environmental effects (including cumulative effects) related to a proposed surface coal mining development in CBRM.

1.5 Organization of the Report

This report consists of the following sections:

- Introduction;
- Public Stakeholder Consultation Program;
- Typical Project Activities and Potential Environmental Interactions;

- Mitigation Measures and Best Management Practices;
- Cumulative Effects Assessment;
- Summary and Recommendations; and
- References.

The Introduction (Section 1.0) provides an overview of the study, study objectives and background. This section also includes the current regulatory framework for surface coal mining operations. Limitations of the study are discussed and the report organization is also presented.

Section 2.0 presents the public and stakeholder consultation program. Methodologies are included, as well as a presentation of the results and a summary of the information obtained during the consultation process.

Typical project activities and potential environmental interactions are outlined in Section 3.0. The project activities described include site preparation, coal extraction and reclamation. Potential environmental interactions with each of the Project activities are also presented.

Mitigation measures and best management practices are discussed in Section 4.0. These measures and practices are presented in consideration of common practices in Nova Scotia, as well as other Canadian jurisdictions and the United States (US). The regulatory process and the necessity for community participation are also included in this section.

Section 5.0 includes a generalized cumulative effects assessment. The methodology, scope and selection of Valued Environmental Components (VECs), as well as development assumptions are presented. Assessments are presented for the following VECs:

- Atmospheric Environment;
- Terrestrial Environment;
- Fish and Fish Habitat;
- Water Resources;
- Land Use;
- Transportation Infrastructure;
- Human Health and Public Safety; and
- Labour and Economy.

A summary of the study findings and recommendations is included in Section 6.0.

Section 7.0 includes literature references and personal communications.

Appendices provide a variety of supporting information including graphics supplied by NSDNR and a public consultation contact list.

2.0 PUBLIC/STAKEHOLDER CONSULTATION PROGRAM

2.1 Methodology

The public/stakeholder consultation included the following main components:

- key informant interviews, in person and by phone;
- meetings with the Port Morien and Boularderie chapters of the Citizens Against Strip Mining;
- a request for feedback on the cumulative effects study, with a toll-free phone number and an e-mail address, distributed at a public meeting hosted by the Hon. Cecil Clarke in Florence on July 12, 2005;
- review of submissions made as part of the Environmental Assessment of the proposed Surface Coal Mine and Reclamation Project at the Prince Mine Site (Pioneer Coal 2005); and
- review of other submissions and presentations on the subject of surface coal mining in CBRM.

Interviews and meetings were conducted with individuals and community groups that have played a significant role in the debate about the future of surface coal mining in CBRM, representatives of municipal government, farmers and fishermen, and the mining industry.

Letters were also sent to the five First Nations on Cape Breton Island and to other Mi'kmaq organizations, requesting comments on issues relating to the cumulative effects study. Organizations have requested more time to respond. Once received, this information will be forwarded directly to NSEL.

In addition the Boularderie chapter of Citizens Against Strip Mining placed an advertisement in the Cape Breton Post with contact information for the study team, encouraging people to register their concerns by phone or e-mail. They also subsequently distributed approximately 1,500 copies of the original request for feedback by mail to residents of the Boularderie Island area. Feedback received by the study team was collated and taken into consideration when preparing this report.

Further information on contacts is included in Appendix C.

2.2 Results

The consultation component of this study sought to identify the range of concerns and opinions held by local residents and other stakeholders.

No attempt was made to quantify public opinion; such a task was outside the scope and resources of the study. Surface coal mining opponents believe that a large majority of CBRM residents agree with their views and point to several indicators including comments and questions at public meetings on this issue, and letters to the editor. Others suggest that the issue is sufficiently polarized that supporters of surface coal mining may feel uncomfortable stating their views in public. Because the degree of community concern is a factor to be considered in environmental assessment, some observations are made in this section regarding the apparent weight of opinion based on the feedback received by the study team via phone and e-mail and a review of the public submissions made to the Minister of Environment regarding the proposed Prince Mine site surface coal operation.

Opposition to new surface coal mining appears to be widespread, well-informed and well-organized. Most of the opposition seems to be based on past experiences in the area. In general, opponents question the need to use the near-surface coal resource, are concerned about impacts of mine operation, are at best dubious about the prospects of being able to effectively reclaim mine sites, and have little or no confidence in the ability or willingness of the surface coal mining industry to avoid environmental impacts, and in the capacity of government agencies to monitor and enforce. The rationale for exploiting the near surface coal resource is also questioned, particularly given its high sulphur content.

Looking at the broader picture, opponents state that surface coal mining is not consistent with what they see as Cape Breton's future — moving away from its "dirty" industrial past towards a cleaner and greener economy. Nonetheless, significant support for a revival of underground mining at Donkin has been voiced.

Support for surface coal mining is not widely evident but certainly exists. It focuses mainly on employment benefits and the potential to replace coal imported by Nova Scotia Power with a locally produced fuel. Although opponents reject the concept of reclamation mining (using surface coal mining to remove hazardous near-surface underground workings and open pits left by bootlegging), some residents have concluded that old mine workings represent an unacceptable risk and that surface mining, especially if accompanied by an infusion of additional resources to enable enhanced reclamation, is a viable way to rescue these lands for present and future generations.

This section identifies the issues and concerns that have been raised during the consultation process and through other forums.

Cumulative Effects Study

Questions were raised about this cumulative effects study. The main concerns were that (a) the mandate of the study appeared to be about "facilitating" surface coal mining through mitigation rather than an unbiased investigation of whether surface coal mining should be allowed to proceed at all, and (b) the study was under-funded and therefore could not support technical investigations of the effects of past mining operations in CBRM — some people questioned the value of a desk-top study.

From the perspective of the Citizens Against Strip Mining (CASM) many of the impacts of surface coal mining cannot be addressed by mitigation measures and best practices, and contingency plans (*i.e.* plans to mitigate after the event if unacceptable impacts occur) are not acceptable.

Using the Near Surface Coal Resource

Many people have criticized DNR's decision to make the near surface coal resource in CBRM available for extraction. Some believe that the use of coal as a fuel should be phased out for environmental reasons. Others point to the high sulphur content of near surface coal in CBRM and believe that a strategy of rushing to use this coal before more stringent sulphur emission caps come into force is irresponsible. Nova Scotia Power's commitment to keep burning coal is questioned in the light of current plans to bring liquefied natural gas (LNG) to Nova Scotia. Surface coal resources are also seen as "a drop in the bucket" compared to the coal that could be available underground at Donkin, and not worth the extent of surface disruption entailed. One suggestion is that the coal should be left where it is for future use in an emergency situation in which other fuel sources are completely severed.

On the other side of the argument, some people believe that it makes no sense to import coal rather than use a local resource. Importation represents a leakage of money out of the Province.

Domestic Coal Market

The main market for coal mined through surface mining operations has been Nova Scotia Power, but there is also a relatively small domestic coal market to supply (a) CBDC pensioners, who are entitled under the terms of their pension to obtain coal from CBDC for home heating purposes at a cost of $7/tonne plus trucking charges, and (b) other domestic users of coal. CBDC has indicated that they need about 20-30,000 tonnes/year of coal and are "desperate" to obtain a reliable source. They currently have a contract with one of the surface mining companies that has had to purchase offshore coal because they do not have current approvals to mine locally.

The issue of continued domestic coal burning has been questioned by a number of surface coal mining opponents who believe that burning coal is not environmentally acceptable and is also not going to be sustainable in the long run. They point to the use of substandard equipment because of difficulties obtaining new coal burning furnaces, difficulties obtaining home insurance where the heating system is coal-fired, and the inconvenience of burning coal, especially for elderly people (hauling coal and ashes). They also suggest that CBDC, rather than subsidizing the cost of coal, should assist its pensioners to convert their heating systems.

On the other hand, some domestic coal users who are not CBDC pensioners have indicated their support for continued surface coal mining because otherwise they have no source of heating fuel (Nova Scotia Power does not currently sell any of the coal it imports to this market).

Extent of Future Surface Coal Mining

The potential full extent of surface coal mining in CBRM is also a big concern. In 2003 NSDNR prepared a confidential planning document that identified ten possible future claim blocks with significant near surface coal resources, and laid out a possible strategy to tender the blocks in three phases. While this document was never adopted as an official plan and was therefore not released, it has nevertheless been widely circulated and the contents are public knowledge. Therefore many people feel that they could be facing not one or two surface coal mining projects but even possibly as many as thirteen (projects on ten claim blocks combined with three other projects at Point Aconi, Halfway Road and Florence that are already in the process).

Economic Benefits

The opponents of surface coal mining often feel strongly that it brings few local economic benefits because the work is highly mechanized and there will be few jobs that only last for a relatively short time. Along with this argument, some people assert that underground mining at Donkin would be employ many more people, although it is likely that this would also be a highly mechanized operation. There have also been concerns expressed that, in the case of Pioneer Coal, a company headquartered off the Island, work crews may not be recruited locally.

Supporters of surface coal mining emphasize that Cape Breton needs industry, and that "not everyone can be farmers and fishermen" and that surface mining could inject millions of dollars into the local economy.

On a provincial scale, some people have stated that the $1/tonne royalty paid by mining companies is insignificant, especially compared to the surface disruption caused by mining.

In general, opponents see surface coal mining as lining the pockets of a few, while local residents are left to cope with the social and environmental impacts of construction and operation, and the long-term legacy of degraded landscapes.

Concept of Reclamation Mining

NSDNR has presented the prospect of new surface coal mining operations as encompassing "reclamation mining" opportunities. (NSDNR recognizes that this does not apply to the Boularderie claim block). Reclamation mining, in this context, is surface mining that removes dangerous underground mine workings and/or bootleg surface workings in the process of extracting near surface coal resources. From NSDNR's perspective, surface coal mining by private operations provides an infusion of resources to address risks and liabilities that would otherwise be left for many years to come. NSDNR currently budgets $50,000 a year to address hazardous mine openings in the whole Province. It is seen as only a matter of time before a serious accident occurs, especially if local knowledge about hazardous areas diminishes over time.

However, opponents of surface coal mining criticize the concept of reclamation mining on several counts. It is widely seen as a ploy to make surface coal mining more palatable. People argue that (a) removal of underground workings and crop pits is usually unnecessary, (b) where real hazards exist, the government should address them directly rather than making the reclamation an adjunct of further mining activity, (c) that using surface mining to remove open pits will strip large areas of vegetation and soil and that other reclamation methods would be cheaper and less destructive, and (d) mining companies would likely be mining well beyond the boundaries of the area containing the hazardous workings, suggesting that only a portion of such a project should be called reclamation mining. Typically, areas that have been heavily crop-pitted or have unstable underground workings do not have much coal left and therefore a mining company would need to mine additional areas in order to make the whole operation feasible.

In the case of underground workings that could present a threat of subsidence, for example under houses in the Birch Grove block, residents argue that homes have been well established in the area without significant problems and that owners are aware of the circumstances. In the case of crop pits, residents argue that often the pits have fallen in and are no longer very deep, and that local people are well aware of the risks of off-trail travel in these areas, as is indicated by the absence of any serious accidents.

However, in Sydney Mines, a group of residents has decided that mine openings and underground workings in the Halfway Road/Tobin Road area do represent an unacceptable risk and they are supporting the development of a surface coal mining project on this site in order to address this risk. The group is critical of the way that surface coal mining has been conducted and regulated in the past and has proposed improvements. The group is also seeking further investment in the reclamation process by other government and NGO partners to enhance future community land use opportunities.

Bulk Samples

As part of the process of determining whether a coal resource can be developed economically, companies may ask for permission to take a bulk sample (up to several thousand tonnes). Bulk sampling can provide additional information about the quantity and quality of the coal and also allow NS Power to carry out a test burn. Excavating the sample also gives the company more information about water production in the pit.

Many people are highly skeptical about the bulk sample process however, believing that they are often unnecessary because the nature of the coal resource should be well known in most areas, and that it is tantamount to mining "by the back door" and should be subject to the same level of environmental assessment as a full-scale mining project. Bulk sample sites at Halfway Road and in the Broughton block that are still awaiting full reclamation are often cited as examples of the problems with the bulk sample process.

Effects of Blasting

The main recent experience with blasting has been associated on the North Side with the Novaco surface coal mine at Point Aconi, the Prince Mine, and activities connected with the construction of the Point Aconi power plant. Other surface mines in this area have relied mainly on excavation techniques. On the South Side residents have complained about blasting at the Gardiner East surface coal mine near Reserve Mines. In the latter case there was considerable dispute about the effects of blasting. Residents in Reserve Mines and further away complained about subsidence, groundwater effects, cracked foundations and air concussion events. The Province commissioned a report by consultants Nolan Davis that concluded that only air concussion events could have been experienced at any distance from the mine and only under certain circumstances. Residents were not convinced of this report.

Concerns about blasting focus on groundwater effects (see section on Groundwater) and also, in the Boularderie area, on the effects on marine water quality, lobster eggs and larvae and on lobster behaviour.

Effects on Groundwater

One of the main issues raised repeatedly is fear of the effects of surface coal mining on groundwater resources. Possible effects identified include:

- changes in groundwater flow caused by blasting;
- direct damage to wells caused by blasting;
- lowering of the groundwater table through pumping to dewater the pit; and
- contamination of the groundwater through the infiltration of acid rock drainage carrying metals and other possible pollutants.

Assurances that mining companies would make rapid restitution for any wells lost through surface mining are often not accepted because residents believe that:

- such promises may be broken and they will need to take the company to court;

- replacement wells, especially if deeper, may provide water of an inferior quality requiring expensive treatment this was cited as a concern in both the Boularderie and Birch Grove/Broughton areas where water from deeper wells often presents manganese and iron problems; and
- other options may be very limited — for example in the Boularderie area the nearest municipal supply at Pottles Lake is already at capacity.

On the North Side communities already have a considerable history of groundwater issues relating to industrial development, particularly around construction activities associated with the Point Aconi Power Plant.

On the South Side there is concern that surface mining could negatively affect the Upper Morien and Lower Morien Aquifers with potentially widespread results. The area in the Birch Grove block is particularly poorly drained and would require extensive dewatering if mining were to occur. The groundwater regime is seen as being very active and capable of spreading any pollution quickly. One concern is that the CBRM well field off the Mira Road could be impacted.

Effects on Surface Water

This concern with regards to surface water quality was voiced more often on the South Side where surface water resources are numerous and varied. The Heavy Water Dam, Sand Lake, John Allen's Lake and the Donkin reservoir supply water to over 30,000 homes in the area. Residents are also very concerned about the possible effects on streams and rivers in the area, including the Mira River, and its tributary streams and rivers, which is a highly valued community amenity and a tourism attraction. CASM points out that numerous lakes, steams, bogs and ponds in or adjacent to purposed mining areas "act like big sponges, storing water and releasing it slowly to maintain the integrity of the watershed". In general, residents expressed a concern with maintaining the quality of surface water resources.

Effects on Farming

Potential effects of surface coal mining on farming was reported as an issue on Boularderie Island where over 500 acres of land, running through the middle of the Boularderie claim block, are used for agricultural production. A local producers co-operative, consisting of five agricultural operations, employs over 250 people with farm gate sales of over $7 million annually. There are also a number of other farming operations in the area.

Farm operators are concerned about impacts to the agricultural land base, especially as much of the land in production is leased rather than owned by farmers. If the owners of these leased lands opted for the short-term gains associated with surface mining, the agricultural community on Boularderie would be jeopardized. The producers co-operative also pointed out most of these lands have been brought into production with investment by the Province.

Access to sufficient quantities of water is an important issue for farmers in the area. Many producers have had to drill new, deeper wells and create irrigation ponds. They are concerned about the effects of blasting and excavation on the wells and the potential for dust from mining operations to settle on irrigation ponds or on crops.

One person also raised the issue of possible changes to Boularderie's favourable micro-climate caused by cutting more trees, resulting in less shelter.

Farm operators in the area also see a future in agri-tourism — tourists visiting or staying on farms, participating in u-pick activities or shopping at farm markets. Highly visible surface coal mining operations may compromise the attraction of these activities.

Representatives of farm operators on Boularderie had at one time indicated that their concerns might be addressed if any future operations in the Boularderie block were limited to the area to the east of the Point Aconi power line. Coastal Construction has been given a Special Licence for Exploration which covers an area of only about 25% of the total Boularderie claim block and is located to the east of the farm lands. However the producers cooperative is now on record as opposing future surface coal mining on Boularderie Island.

Effects on Fishing

Concerns indicated by fishers include sedimentation in marine waters, possible contamination through the release of acidic water containing metals, dust settling on the surface and potentially affecting lobster eggs and larvae, and the effects of blasting. In the Port Morien there is also concern that contaminated waters from surface operations could reach the coastline close to a the water intake for the local fish plant.

Fishers in Boularderie have already experienced loss of lobster grounds close to the Point Aconi Power plant as a result of and the impacts of construction and the discharge of warm water from the plant. One estimate is that as much of 25% of the fishing area between Alder Point and Black Rock was lost in this way, displacing 3-4 fishers.

Fishers report water quality and habitat impacts from earlier surface mines in the area and from the Prince Mine. They also report that these areas are slowly recovering. After approximately 30 years, fishers are gradually reported to be trapping closer to the areas closest to Brogan's former Point Aconi operation.

It was pointed out that it is often very difficult to prove cause and effect in the case of fisheries effects because so many factors are at play in the ocean. In addition, if lobster catches start to decline, a fisher may not be able to afford to continue to fish in a given area in order to "prove the loss", and then moves to another area, which spreads the adverse effect to other resource users as well. It was suggested that if future surface coal mining projects were to be approved, a new model of community involvement and monitoring should be developed, in association with a compensation agreement to protect fishers in the event of any adverse effects. A similar approach was developed in connection with the Middle Shoal dredging project.

Concerns About Trucking

Potential truck traffic is a concern to local residents. In the Boularderie area in particular people are very familiar with coal trucks on local roads and highways, associated both with former surface coal mining operations and with the Point Aconi power plant. Issues include the number of trucks and their timing, their use of roads through residential areas, the speed at which they are driven and the damage they may do to highways. One person referred to hydroplaning hazards caused when heavy trucks create hollows in the road surface, which then fill with water.

Effects on Wildlife Habitat

People often cite destruction of wildlife habitat as one their main concerns about surface coal mining. Forest and wetland habitats are removed and are replace by an active industrial operation and then by a large open area for many years. This contributes to the fragmentation of habitat. On Boularderie, several people noted reports of the existence of pine martens on the island as one notable wildlife resource. On the South Side a major concern is the use of Morien Bay and its associated marshes and sand flats as a staging area by many species of birds in large numbers.

Effects on Tourism

A number of people and groups have indicated that they feel surface coal mining is simply not compatible with tourism which, in Cape Breton, is mainly based on the appeal of the natural scenic beauty of the landscape and coasts and on the pristine nature of the environment. Many people cited the fact that National Geographic Traveler recognized Cape Breton Island as the number two destination in the world for sustainable tourism. Surface coal mining is seen as a potential visual blight and also as a perceived source of contamination. On the North Side people are concerned about the view from Kelly's Mountain as visitors approach the Boularderie area, and about possible environmental impacts on the Great Bras d'Or and Little Bras d'Or Guts which serve as the northern gateways to the Bras d'Or Lakes. A question has also been asked about possible impacts on Bird Islands, a significant eco-tourism attraction.

On the South Side, there are concerns about the potential effects of surface mining on Morien Bay and especially the seabird and waterfowl habitat behind the sand bar, which is seen as being an eco-tourism destination. The Port Morien Development Association has also been working on a number of tourism related projects in the area and there are concerns that surface coal mining would compromise the attraction of the area. (PMDA is overseeing the spending of $500,000 on infrastructure improvements including new street lighting, a town square, historic panels and refurbished look-offs).

Property Values and Community Destabilization

Many people believe that surface coal mining operations will have a deleterious affect on property values and on the willingness of others to buy or build in the vicinity. In the Port Morien area it was reported that a couple enquiring about residential opportunities changed their minds after hearing about the possibility of new surface coal mining activity.

Community destabilization has also been cited as a possible effect. Land or easement purchase by coal mining companies could have a domino effect. A landowner may not wish to sell but may feel pressured if their neighbour does, fearing that mining activity next door will devalue their land anyway. In the context of the proposed Prince Mine surface coal mine the proponent is proposing, if required, to purchase a number of homes near the proposed mine site in Point Aconi, and one public comment on the EA Report questioned the effect of this on the small community in the area.

Track Record of Mining Companies

Many concerns have been raised about the track record of some of the companies that have been involved in surface coal mining and these obviously negatively affect public confidence in future proposals. Issues raised have included mining without approvals, the direct discharge of sediment laden mine waters into the sea, the timing of reclamation, and the quality of reclamation. One mining company was charged with failing to obtain necessary approvals to mine at Merritt Point under the *Environment Act*, was fined and is currently under a Court Order to reclaim the site. Another individual allegedly removed coal from private property without the owner's permission. In another instance, members of the community monitoring mining activities in the Little Pond area notified DFO that a ditch had been dug to drain two settling ponds into coastal waters but charges were not laid.

CASM has questioned whether the track record of a proponent is taken into account when a new proposal is being reviewed. This question was asked at a meeting with Ministers Morash (NSEL) and Hurlbut (NSDNR) on March 22, 2005. In a subsequent letter to CASM dated April 20, 2005, Minister Morash stated that "Special licences and leases are awarded on the merits of the application and in accordance with the applicable legislation. Past mining practices and/or convictions are not part of the evaluation process but may have a bearing on the level of scrutiny the companies' operations receive".

Several people have suggested that at least companies should be required to complete reclamation satisfactorily on one surface coal mining site before being given approvals to start mining at another location.

Reclamation

Reclamation of surface coal mining sites is a huge issue in this whole debate. The key questions revolve around:

- what the objectives of reclamation should be;
- when reclamation should begin;
- how long a company should have to complete reclamation; and
- how government should enforce these requirements.

There is clearly little agreement between NSDNR and local communities about what constitutes satisfactory reclamation and whether existing old sites have achieved this. NSDNR does not have formal standards with respect to reclamation but generally wishes to see a site that has been backfilled, contoured for final use, with all hazards removed and environmental issues addressed, and with a sustainable vegetation cover established.

Community representatives however talk in terms of lost productivity, diversity and habitats, and are not satisfied when a mixed forest community is removed in order to carry out surface coal removal and then replaced by grassland vegetation. Topsoil retention and enhancement is seen as critical and often not achieved. Observers complain that topsoil is not segregated properly or is spread thinly on a coarse substrate and washes away. They also say that surfaces are not properly prepared leaving pitted and ponded areas.

On the Novaco site at Point Aconi the operator did plant trees but residents point to their very slow growth as evidence of lost soil productivity. At the Gardiner East site near Reserve Mines, 12 years after mining stopped, some tree growth through natural regeneration is occurring but the site is still largely open and is also experiencing problems with evident acid rock drainage around the perimeter of the lake that was created. Residents in this area are very critical of what has been achieved and have no confidence that the site is on its way to developing a range of forested and wetland habitats comparable to its original condition.

The bulk sample sites at Halfway Road have been contoured but the operator is having considerable difficulty re-establishing any kind of vegetation. The bulk sample site at Broughton is still unreclaimed, three years after activity ceased, because the mining company indicated that they were still interested in pursuing full development of the site. A reclamation plan has now been submitted. Residents have been extremely concerned about the existence of this excavation for safety reasons and because the pit is filled with acidic water. Drainage from the pit has entered a nearby marsh and from there entered a tributary to Black Brook. Residents are also concerned about water from the pit migrating into the groundwater.

Questions have been asked about the reclamation bonding process, how an appropriate amount is calculated, whether this would be really adequate to ensure complete remediation, and when and why bonds are released.

Some people question whether surface coal mining would in fact be economically feasible if the full cost of returning the land to its previous level of productivity was calculated into the costs of mining the coal.

The Cumulative Effect of Surface Coal Mining on the Landscape and on Land Use

Surface coal mining projects are obviously not viewed as isolated projects. Opponents of surface coal mining say that the impacts are experienced in conjunction with the impacts of other surface and underground coal mining activities in each area and also in conjunction with other industrial developments and activities, particularly the Point Aconi power plant on Boularderie.

On both the North and South Sides, residents point to the legacy of environmental damage caused by earlier exploitation of coal. In some cases landscapes and water resources are gradually recovering, after many years, and the prospect of new surface mining is seen as an unacceptable step backwards.

Confidence in Government Capacity to Regulate Effectively

Similarly, many people have questioned government's ability to monitor surface coal mining activities and to enforce regulations. Issues relate to the concerns about the industry's track record as indicated above and particularly to the reclamation bonding process which has been criticized by some as being ineffective. There are questions about the amount and adequacy of bonding required, and the standards and guidelines for releasing bonds.

Transfer of Federal Lands to the Province or Private Interests

CBDC still holds a significant inventory of lands (approximately 500 parcels including 35 "major sites") in CBRM inherited from various coal mining companies and interests. Some of these lands are impacted by coal activities and are being or will eventually be remediated. Other lands do not include active liabilities but may have near surface coal resources. Some people have raised this as an issue, expressing concern over the prospect of these lands being transferred either to private interests or to the Province which could then facilitate further surface coal mining. As an example, CASM had heard that CBDC was proposing to turn over a large block of land in the Birch Grove area to the Province. In CASM's view, this is not a "prudent use of land and valuable wildlife habitat". CASM believes that CBDC is already spending millions of dollars on the reclamation of coal impacted lands, and should not be transferring lands to facilitate an activity that would create new liabilities.

Municipal Perspective

The Cape Breton Regional Municipality Council is on record as being very concerned about future surface coal mining activities in the municipality and earlier this year passed three motions that:

- support Citizens Against Strip Mining;
- request amendment of the *Environment Act* or its regulations to prohibit issuing surface coal mining approvals within a public water supply watershed area;
- authorize the Planning Advisory Committee to investigate options to use existing powers under the CBRM regional plan or to request additional powers from the Province to "create enhanced restrictions on the issuance of permits for the operation of Strip Mines"; and
- explore options in Provincial legislation that could give CBRM decision-making power to "prohibit strip-mining activities in CBRM, and in particular watershed areas."

However, at least one councillor has expressed guarded support for the continuation of surface coal mining, under stringent conditions, because it does provide much needed local employment and has the potential to stabilize hazardous sites.

The Municipality of the County of Victoria has also passed a motion opposing surface coal mining. A small portion of the Boularderie claim block lies within Victoria County.

CBRM is concerned that the Province did not consult with them before putting the four claim blocks up for tender. Representatives suggested that this was likely related to the current levels of tension between the municipality and the Province on a number of issues and particularly CBRM's stated intention to take the Province to court over municipal funding levels. By contrast it was pointed out that Public Works and Government Services Canada (PWGSC), acting on behalf of the Cape Breton Development Corporation, has established good communications with the Council including briefings for Council as a whole each year and in advance of any new remediation activities, and briefings for individual councillors as appropriate. PWGSC is managing remediation projects for CBDC at coal-impacted sites throughout CBRM

Local opposition to surface coal mining threatened at one point to derail the completion of the new regional plan for the municipality. Many residents found it difficult to believe that the municipality has no control over surface coal mining and other extractive activities, and came out in force at regional planning consultation sessions to express their opposition.

In broad terms, municipal staff have indicated that surface coal mining is not compatible with the new identity and development directions supported by CBRM. Industrial development in the past had significant impacts on environmental quality and landscape integrity, but this was accepted as the price to be paid for employment and community prosperity. This attitude has changed. CBRM has "turned the corner on coal" and wants to put the "dirtier" past behind them. It was pointed out that while Nova Scotia Power burns three million tonnes of coal a year, the surface coal resources in CBRM are only a "drop in the bucket" and that CBRM would not want to base their economic development strategy on the development of this limited resource, especially as there appear to be are few secondary and tertiary development opportunities associated with surface coal mining.

Surface coal mining would likely not increase municipal revenues and could increase costs through wear and tear on roads, possible decreases in property assessments, and conflicts with other developments.

Protection of water supply areas is an important issue for the municipality, which has nine surface water supply watersheds and one well field. Only one surface water supply watershed, Sand Lake, is a Protected Watershed. The others are only protected by the regional plan. Potential conflicts between water supply protection and surface coal mining were flagged as being particularly prominent in the Birch Grove and Broughton areas.

Industry Perspective

Interviews could only be conducted with two surface coal mining company representatives. They indicated that opposition to surface coal mining probably stems from a broad range of reasons, many of which, such as the legacy of underground coal mining activities carried out before environmental management was considered important, are out of their control. It was pointed out that surface coal mining, which involves many of the same activities associated with other types of development (for example, residential and commercial development, highway construction) including land clearing and excavation, has been to a certain extent "demonized" in the public eye. Companies have also had success in carrying out surface coal mining operations with little or no public controversy in areas, such as Debert, where there has been no other coal mining activity.

Pioneer Coal believes that they have an excellent track record in Pictou County and they point to successful negotiations with the Towns of Stellarton and Westville leading to land in the centre of these communities being reclaimed and turned over for community uses. Pioneer's development of highwall mining technology has contributed to minimizing the footprint of surface operations.

Environmental management practices have improved significantly. Dust can be controlled by various means to eliminate off-site impacts. The science of blasting has also improved, and the community can be involved in deciding what blasting strategy is the most acceptable (larger infrequent blasts or smaller, more frequent blasts). Protocols for protecting or, if necessary replacing, residential water supplies are well developed, and groundwater levels usually rebound in about a year after the completion of mining.

Several suggestions were made for procedural improvements from an industry perspective. Companies proposing new projects with a reclamation mining component feel that they are largely left to defend this objective on their own, before a skeptical public. If it really in the Province's interest to remediate hazardous underground and surface workings in these areas, then the Province should make a clear statement to this effect.

A second suggestion was that, given that past reclamation practices have in many cases not been adequate and that this is contributing to public distrust of the present day surface coal mining sector, a portion of the existing or perhaps increased coal royalties should be earmarked for a fund to improve conditions at old mine sites.

A third suggestion from industry was to take a hard look at the bulk sample approval process. Bulk sample excavations, which are often contentious, should only be allowed after stringent review to ensure that they are absolutely necessary and should undergo an appropriate level of environmental assessment.

Consultation and Ongoing Community Involvement

NSDNR has been criticized from many quarters for the lack of consultation with the municipality and with local communities before proceeding to tender the four claim blocks. In addition, CASM has complained about their inability to obtain any information about the mining plans put forward by the companies that responded to the tender. Efforts to obtain this information through the Freedom of Information procedure were not successful. From NSDNR's perspective, these proposals must remain confidential because they contain proprietary commercial information.

Subsequently there has been considerable dialogue between representatives of the provincial government and local organizations on this issue. NSEL has endeavoured to maintain liaison with both chapters of CASM and the Ministers of Environment, Natural Resources and Energy have been involved in meetings. NSDNR has also offered to meet with CASM but this offer has not been taken up.

A notable feature of the current opposition to surface coal mining is that many people are spending many hours, doing research, documenting local issues and problems, organizing and attending meetings, briefing visitors and contributing to studies such as this one. For example, a document "Backgrounder on Effects of Surface Coal Mines in CBRM" has been prepared by CASM (CASM 2005) as input to this cumulative effects study. It has been pointed out that this is one of the early impacts of surface coal mining — namely consuming vast amounts of residents' time and raising their stress levels.

The industry has been criticized for not being prepared to enter into real consultation with communities. Residents suggested that the consultation program associated with the Prince Mine surface coal proposal was not considered to be adequate. (Pioneer Coal conducted an open house with displays in a trailer located on the Prince Mine site for two days.) There have also been questions about the potential formation of community liaison committees (CLCs) to provide community input to projects. Some people believe that CLCs should be in place when projects are at the proposal stage so that the community can influence project design. Others question the effectiveness of CLCs because they usually lack decision-making powers.

View Expressed in Phone and Written Feedback

Twenty-eight people provided written feedback to the study team, and 52 people called the toll-free number, either leaving a message or speaking directly with a study team member. Of the 52, the majority left their name. Only 8 anonymous calls were received. The majority of these responses were opposed to surface coal mining in CBRM. Two people wrote to express their support, and a third person indicated that surface coal mining could be acceptable in certain circumstances, with appropriate environmental and community management.

The issues raised in the feedback cover the range identified in this section, with concerns raised about effects on wells and, by extension, on the viability of homes in the area; effects on surface water, wildlife, fishing and farming, the area's beauty and its attraction to tourists and prospective residents. Respondents are not convinced by assertions of local and regional benefits. A number of people cited their own or their family's negative experiences with past surface coal mining operations, indicating significant adverse effects during the operation phase and dissatisfaction with initial reclamation activities and subsequent site recovery.

By far the most prevalent recommendation included in the feedback is that surface coal mining not proceed in CBRM. A few other people suggested, that if a project is allowed to proceed, conditions and management should include the following:

- no use of explosives;
- requirement for a bond to cover costs of replacing wells;
- requirement for a protection zone around local residences;
- secure fencing around the mine site until the completion of reclamation;
- free home building inspections in the area around the mine site to be used in case of damage claims;
- adequate and timely monitoring and enforcement by NSEL;
- wastewater treatment;
- stringent dust controls;
- higher reclamation standards; and

- effective community involvement in ongoing project monitoring with adequate resources.

Supplemental information gathered from community consultations is presented in Appendix D.

2.3 Summary

The majority of voices heard in the public consultation are opposed to the development of new surface mines in CBRM. Public meetings held to discuss the issue attract large numbers of participants; few if any speak in favour. The industry is widely seen as having already left an unacceptable legacy of poorly reclaimed sites, and threatening to cause further environmental damage while delivering virtually no local benefits. The people and institutions of CBRM feel that they were not involved in the planning process through which decisions were made to put new claim blocks up for tender, and so surface mining is widely seen as being foisted off on the area with no local input.

Public opinion is, of course, not monolithic, and a number of people have indicated support for surface mining mostly on the grounds that it does provide some local economic benefit, and also because of its potential contribution to the reclamation of hazardous areas. However, many people have now invested long hours in the fight to reject further surface coal mining, backed by the municipality, and have strong resolve to reject all new projects. Table 2.1 provides a summary of issues identified in the public consultation and concordance to the rest of the Report.

TABLE 2.1 Summary of Issues Identified in the Public Consultations and Concordance to the Report

Issue	Report sections where the issue is addressed
Need for projects ▪ Better quality coal can be obtained from other sources. ▪ Projects would substitute a local resource for an imported resource (economic benefits) ▪ Domestic coal use should be phased out because of environmental impacts and other problems (for example, insurance availability). ▪ Domestic coal users need a local source of coal.	2.2
Cumulative land effects ▪ Concern about potential for amount of land in CBRM affected by surface coal mining effects if additional claim blocks are made available.	2.2, 5.5.1, 5.6
Economic benefits ▪ Few local benefits because surface coal mining entails few jobs that may, in addition, not be available to local people ▪ Royalties on coal are low. ▪ Surface coal mining could be an important source of new employment and local business spin-offs in CBRM.	2.2, 3.2, 5.5.4, 5.6, 6.1

TABLE 2.1 Summary of Issues Identified in the Public Consultations and Concordance to the Report

Issue	Report sections where the issue is addressed
Reclamation of hazardous coal-impacted lands through surface coal mining ▪ Degree of hazard, and therefore need to reclaim, disputed. ▪ Alternative means of reclamation are available; surface coal mining not required. ▪ Province and/or CBDC should discharge their liabilities, without making lands available for surface coal mining. ▪ Surface coal mining, done properly, is a valid way of reclaiming hazardous lands and likely the only way that resources will be made available to do the job.	2.2, 3.1.3, 3.2, 4.1, 4.2, 5.5.3, 5.6
Bulk sample process ▪ Bulk sampling is surface coal mining that is not subject to the same level of controls.	2.2, 6.2
Blasting ▪ Effects on groundwater, land subsidence and air concussion. ▪ Effects on lobster.	2.2, 3.2, 4.1, 4.2, 5.4.1.2, 5.6
Groundwater ▪ Likelihood of wells being lost ▪ Difficulty obtaining equivalent replacement water supply ▪ Proponent procedures to guarantee timely replacement of wells ▪ Destabilization of communities through widespread groundwater impacts	2.2, 3.2, 4.1, 4.2, 5.4.4, 5.4.4.2, 5.6, 6.1
Agriculture ▪ Loss of agricultural land if leased land in claim block is turned over to surface coal mining. ▪ Impacts on irrigation water sources through impacts on groundwater ▪ Dust impacts on irrigation ponds or crops ▪ Reduced sales or impacts on agri-tourism potential through perceived association of area with surface coal mining.	2.2, 4.1, 4.2, 5.5.1.1
Fishing ▪ Effects of blasting on lobsters ▪ Water quality impacts (discharge of acidic water or suspended solids) ▪ Sedimentation of lobster habitat ▪ Need for compensation guarantees and community involvement in monitoring.	2.2, 3.2, 4.1, 5.4.3, 5.4.3.2
Trucking ▪ Volume of and speed of truck traffic ▪ Damage to roads and highways.	2.2, 3.2, 4.1, 5.4.2.2
Wildlife habitat ▪ Removal of habitat ▪ Damage to habitat caused by off-site impacts (dust, acidic drainage, sedimentation)	2.2, 3.2, 4.1, 5.4.2.2, 6.1
Tourism ▪ Visual impacts, especially from view Kelly's Mountain ▪ Association of area with surface coal mining not compatible with attraction of scenic beauty and pristine environment	2.2, 5.5.4, 6.1, 5.5.1.1

TABLE 2.1 Summary of Issues Identified in the Public Consultations and Concordance to the Report

Issue	Report sections where the issue is addressed
Community impacts ▪ Adverse impacts on property values ▪ Potential new or returning residents deterred by presence of surface coal mining projects ▪ Community destabilization if landowners feel forced to sell land for surface coal mining expansion	2.2, 5.5.1
Proponents' capacity to avoid environmental impacts ▪ Concern about track record of surface coal mining companies.	2.2
Reclamation ▪ Current reclamation standards seen as being too low. ▪ Concern about loss of topsoil and productivity ▪ Adequacy of reclamation bonding Landscape impacts ▪ Cumulative landscape impacts of new surface coal mining operations together with older coal-related landscape impacts	2.2, 3.2, 4.2, 5.5.1, 6.2, Appendix E
Government capacity to regulate ▪ Ability to monitor surface coal mining activities and enforce regulations.	2.2, 5.6, 6.1, 6.2
Municipal issues ▪ Surface coal mining not compatible with preferred economic development direction for CBRM ▪ Lack of consultation with municipality regarding future of surface coal mining in region ▪ No municipal benefits, potential for increased infrastructure costs ▪ Protection of water supply watershed areas.	2.2, 5.5.4
Community consultation ▪ Concern about lack of public involvement in decision to open up new claim blocks for surface coal mining ▪ Concern about community consultation carried out by surface coal mining companies.	2.2, 4.1, 6.2

3.0 TYPICAL PROJECT ACTIVITIES AND POTENTIAL ENVIRONMENTAL INTERACTIONS

Surface coal mining is accomplished by removing overburden material above the coal seam and subsequently removing the coal. The productivity of a mine is directly related to the ratio of the amount of overburden excavated to the amount of coal removed.

There are several types of surface coal mines including: area surface mines; contour mines; and open pit mines. Area surface mines, usually found in flat terrain, consist of a series of cuts 30 to 60 metres (100 to 200 feet) wide. The overburden from one cut is used to fill in the mined out area of the preceding cut. Contour mines occur in mountainous terrain and follow a coal seam along the side of the hill. When contour mining becomes too expensive, additional coal can often be produced from the mine's highwall by the use of augers or highwall miners. Open pit mining is usually found where coal seams are thick. Open pit mines can reach depths of several hundred feet.

The following is a description of typical activities associated with surface coal mining that could likely be developed in CBRM. Information related to typical surface coal mining activities was obtained largely from recently proposed projects in CBRM (Pioneer Coal Ltd. 2005; Thomas Brogan & Sons Construction Ltd. 2004; Pioneer Coal Ltd. 2004) and from elsewhere in Canada and in the US.

3.1 Project Activities

In general, on site activities associated with surface coal mining operations include: site preparation; coal extraction; coal transportation; and reclamation. Each of these activities is further detailed in the following sections.

3.1.1 Site Preparation

Surface coal mine development begins initially with construction or upgrading of necessary infrastructure such as access roads and water management structures. These activities will vary depending on the location of the proposed development relative to existing infrastructure and the size of the development. In some instances, access roads may already exist and will only require minor upgrading, while in other instances, construction of new access roads may be required. Water management structures may include: ditching to divert clean surface water around the site; construction of settling ponds; and installation of other erosion and sediment control features, such as check dams and silt fencing.

Timber harvesting and grubbing (*i.e.*, removal of stumps and low brush) may be required, depending on the site to be developed. Typically, these activities are undertaken on a progressive basis to limit the open areas to only what is required for active mining.

Other site preparation activities may include: installation of safety fencing; construction/installation of office facilities, lunchroom, and sanitary facilities; surveying; topsoil stripping (and preservation); and removal of overburden (*i.e.*, layers of earth, rock and other material covering a coal seam). In some instances, blasting may be required to remove hard/dense overburden.

Draglines are large excavating machines used to remove the overburden in large surface mining operations, such as the Highvale Mine located 70 km west of Edmonton, Alberta. The dragline is one of the largest land based machines in the world. It has a large bucket, suspended from the end of a large boom which may be as long as 90 m (300 feet). The bucket, which is suspended by cables, is able to scoop up great amounts of overburden as it is dragged across the excavation area. Some buckets have capacities of up 250 tons.

Storage areas for topsoil and overburden are appropriately sized during the planning phase of mine development. Storage areas are constructed with appropriate drainage collection. Runoff is typically directed to the site's main surface water management system to ensure appropriate levels of treatment (*e.g.*, settling of suspended solids) prior to discharge off-site.

Where surface mine development is undertaken close to residential areas, mine planning activities may include: purchase and or relocation of houses; provision of alternate water supplies and road access; and construction of berms to serve as noise, dust and visual barriers.

Where surface coal mine development is undertaken in an area with historic underground mining and/or bootleg mining, there are opportunities for reclamation of these abandoned sites. Reclamation activities may include: dismantling and proper disposal of infrastructure; excavation of shallow underground workings and backfilling to remove a subsidence hazard; dismantling and burial of old coal waste piles that may generate acid runoff; surface water treatment; and ultimately reclamation of the entire site.

3.1.2 Coal Extraction and Transportation

As a method of coal extraction, surface mining accounts for about 99.5% of the total Canadian coal production (Kevin Stone, NRCan., pers. Comm., July 2005) and about 60% of total U.S. coal production. It permits recovery of as much as 95% of the deposit due to the accessibility of the coal and the efficiency of current equipment.

The method of extraction of the resource typically depends on a number of factors such as: the amount of overburden to be removed; the geology and structure of the coal seam; the amount of coal to be extracted; and the type of equipment available to the mine operator. The following is a description of the types of extraction methods and equipment typically used for surface coal mining.

A recently proposed project in CBRM (north of the Point Aconi Resource Block) intends to extract coal from a series of parallel box cuts utilizing large dozers complete with rippers, a large hydraulic excavator and rock trucks. This method is often considered when production rates are low and use of other extraction equipment is limited due to accessibility or cost.

Another recently proposed project in CBRM (Point Aconi Resource Block) proposes the use of a highwall miner for the extraction of coal. This technique is currently in use at the Stellarton Pit Mine in Stellarton, NS. Highwall mining is a method of coal mining in which a continuous mining machine is driven under remote control into the seam exposed by previous open cut operations. A continuous haulage system carries the coal from the miner to an open-air installation for stockpiling and transport. This process forms a series of parallel, unsupported drives that are separated by the coal pillars which remain between adjacent drives and are capable of supporting the overburden structure.

One of the key factors for a successful mining operation of this nature is the continuous operation of the equipment. Once a cut has commenced, extraction continues until the cut has reached the desired length. Removal of the equipment before the cut is complete usually necessitates abandonment of the remaining resource within the cut due to the accumulation of water within the cut.

Highwall mining is beneficial in that the land surface disturbance is minimized which also results in lower reclamation costs.

Mined coal is typically removed from the pit or excavation by means of a conveyor or large off-road trucks. Coal is typically stockpiled on site in a temporary transfer facility and subsequently loaded onto standard tractor-trailor trucks or rail cars (where rail service is available) until it is transported to market.

3.1.3 Reclamation

Reclamation of a surface coal mine means returning the disturbed mine area to pre-development conditions, or better, and includes (but is not limited to) backfilling the open cut areas, contouring, and revegetation. Comprehensive and effective reclamation is a standard and integral part of modern coal mining operations. Without reclamation, the effects of surface mining can be seen for many years. Historically, surface coal mining developments were not reclaimed and were left open and unstable. The unstable conditions are unsuitable for most land uses such as agriculture and recreation and present safety hazards. Furthermore, wildlife would continue to be affected by the loss of vegetation and habitat for some time into the future. As a result, reclamation is critical.

In more modern surface coal mining developments/operations, reclamation it is often undertaken progressively (*i.e.*, reclamation begins in depleted areas while other areas are still being actively mined). For example, where a mine is developed in blocks or box cuts, overburden from the second block is used to backfill the first. Once a sizeable area has been backfilled, the area is graded, contoured (including establishment of site drainage) and covered with topsoil and revegetated, depending on the approved/predetermined reclamation plan and intended end land use. The goal of revegetation is to provide ground cover to prevent soil erosion, support local flora and fauna, encourage ecological restoration and ultimately return to a naturally functioning ecosystem.

In some cases, as is intended for some areas within the four resource blocks in CBRM, reclamation mining is proposed. This type of mining is considered for areas subject to historical mining activities (*e.g.*, underground mining, bootleg mining) that have a sufficient amount of coal remaining for the development to be economically feasible, that were never properly reclaimed, and present a hazard to public safety as well as other environmental and aesthetic concerns. The intent of reclamation mining in these areas is to improve their condition compared to current conditions and allow the reclamation to be funded by the extraction of the residual coal.

To ensure reclamation is complete to the satisfaction of landowners and the government, the Province of Nova Scotia imposes a reclamation bond on mine operators. Upon completion of active mining and successful reclamation of the site and upon review of the work by regulatory agencies, the bond is released. Progressive reclamation ensures sites are completely reclaimed within a relatively short period of time after mining is complete.

3.2 Potential Environmental Interactions

The potential for environmental and socio-economic interactions exists within all phases and activities associated with mine development. Some interactions are positive (*i.e.*, potential benefits to local and regional economy) and some are negative (*i.e.*, potential disruption to wildlife). Table 3.1 summarizes the potential interactions between surface coal mine developments and the environment.

TABLE 3.1 Potential Interactions Between Project Activities and Environmental Components

Project Activity	Environmental Component				
	Atmospheric Environment	Aquatic Resources	Groundwater Resources	Terrestrial Environment	Socio-economic Environment
Access Road Construction	▪ Dust (A) ▪ Equipment noise (A) ▪ Equipment emissions (A)	▪ Potential for culvert installations or upgrades (A) ▪ Potential for sedimentation and habitat disturbance (A)	▪ None anticipated	▪ Loss of habitat (A) ▪ Habitat fragmentation (A) ▪ Wildlife disturbance due to noise/human presence (A)	▪ Potential for disruption to traffic (A) ▪ Contribution to local work force/economy (P)
Development of Surface Water Control Structures	▪ Equipment noise (A) ▪ Equipment emissions (A)	▪ Reduce/prevent potential for sedimentation (P)	▪ None anticipated	▪ Loss of habitat (A) ▪ Wildlife disturbance due to noise/human presence (A)	▪ Contribution to local work force/economy (P)
Clearing	▪ Equipment noise (A) ▪ Equipment emissions (A)	▪ Disturbance of riparian habitat (A)	▪ None anticipated	▪ Loss of habitat (A) ▪ Habitat fragmentation (A) ▪ Wildlife disturbance due to noise/human presence (A)	▪ Contribution to local work force/economy (P) ▪ Changes to land use (A)
Grubbing	▪ Equipment noise (A) ▪ Equipment emissions (A)	▪ Potential for erosion and sedimentation (A)	▪ None anticipated	▪ None anticipated	▪ Contribution to local work force/economy (P) ▪ Changes to land use (A)
Topsoil Stripping	▪ Equipment noise (A) ▪ Equipment emissions (A) ▪ Dust (A)	▪ Potential for runoff and sedimentation (A)	▪ None anticipated	▪ None anticipated	▪ Contribution to local work force/economy (P) ▪ Changes to land use (A)
Removal of Overburden	▪ Equipment noise (A) ▪ Dust (A) ▪ Equipment emissions (A)	▪ Potential for runoff and sedimentation (A) ▪ Potential for runoff and changes to water quality (A)	▪ Potential effects on down gradient wells (A)	▪ None anticipated	▪ Contribution to local work force/economy (P) ▪ Disturbance to communities (A) ▪ Alterations to viewscape (A) ▪ Changes to land use (A)
Blasting	▪ Noise (A) ▪ Dust (A)	▪ Potential for sedimentation (A) ▪ Direct fish mortality (A)	▪ Potential changes to well water quality and quantity (A)	▪ Disturbance to wildlife (A)	▪ Contribution to local work force/economy (P) ▪ Disturbance to communities (A)

TABLE 3.1 Potential Interactions Between Project Activities and Environmental Components

Project Activity	Environmental Component				
	Atmospheric Environment	**Aquatic Resources**	**Groundwater Resources**	**Terrestrial Environment**	**Socio-economic Environment**
Storage of Material	▪ Dust (A)	▪ Potential for erosion and sedimentation (A) ▪ Potential for runoff and changes to water quality (A)	▪ Potential changes to water quality (A)	▪ None anticipated	▪ Contribution to local work force/economy (P) ▪ Changes to land use (A)
Coal Extraction	▪ Methane release (A) ▪ Equipment emissions (A) ▪ Dust	▪ Potential for runoff and changes to water quality (A)	▪ Potential for changes to water quality (A) ▪ Potential for lowering of the water table (A) ▪ Potential for well collapse due to subsidence (A) ▪ Pumping of excavation water (A)	▪ None anticipated	▪ Contribution to local work force/economy (P) ▪ Reduce safety concerns related to unrestricted access to old mine workings (P) ▪ Alterations to viewscopes (A) ▪ Changes to land use (A)
Coal Transportation	▪ Dust (A) ▪ Vehicle emissions (A)	▪ None anticipated	▪ None anticipated	▪ None anticipated	▪ Contribution to local work force/economy (P) ▪ Increased traffic on local roads (A) ▪ Changes to land use (A)
Reclamation	▪ Equipment emissions (A) ▪ Dust	▪ Potential for runoff and sedimentation (A)	▪ None anticipated	▪ Restoration of habitat (P)	▪ Contribution to local work force/economy (P) ▪ Reduce safety concerns related to unrestricted access to old mine workings (P) ▪ Changes to land use (A, P)
Key A = potential adverse effect P = potential positive effect					

4.0 MITIGATIVE MEASURES AND BEST MANAGEMENT PRACTICES

4.1 Mitigative Measures and Management Practices in Nova Scotia

The following is a description of mitigative measures and management practices proposed for and applied to surface coal mining projects in Nova Scotia. Information to support this description was obtained from recently proposed surface coal mining projects in CBRM (Pioneer Coal Ltd. 2005; Thomas Brogan & Sons Construction Ltd. 2004; Pioneer Coal Ltd. 2004) as well as operating approvals for various existing operations and other similar operations.

TABLE 4.1 Summary of Standard Mitigative Measures and Management Practices Applied in Nova Scotia

Activity or Issue of Concern	Mitigative Measure and Management Practices
Erosion and Sediment Control and Surface Water Management	▪ Divert clean surface water away from disturbed areas ▪ Design site drainage system to collect surface runoff from active areas for the removal of suspended solids ▪ Construct properly sized settling ponds for the treatment of suspended sediment (*i.e.*, minimum 24 hour duration and 25 year return period storm event) ▪ Clearing and grubbing requirements will follow a work progression schedule limiting the areas open to those required for mining activities ▪ Stabilize erodible material with rock, mulch, geotextile or hydroseed ▪ Install sediment control fencing and other measures (*e.g.*, check dams and diversion berms) as required ▪ Use coagulant, when required, to meet effluent objectives ▪ Ensure proper maintenance of all erosion and sediment control structures ▪ Sediment removed from structures to be disposed of in a manner to prevent it from entering a watercourse (*e.g.*, as backfill in the mine excavation) ▪ Conduct work in accordance with the Erosion and Sediment Control Handbook for Construction Sites
Aquatic Resources	▪ Establish minimum 30 m buffer from watercourses ▪ Ensure requirements for offsite discharge of surface water are met ▪ Monitor effluent in accordance with NSEL permit conditions
Flora and Fauna	▪ Avoid disturbance to rare or sensitive species ▪ Apply principle of no net loss of wetland habitat ▪ Clearing activities to avoid sensitive period for breeding birds (*i.e.*, outside of the breeding season for most birds, which is April to August) ▪ Develop and train staff on wildlife encounters procedures

TABLE 4.1 Summary of Standard Mitigative Measures and Management Practices Applied in Nova Scotia

Activity or Issue of Concern	Mitigative Measure and Management Practices
Dust	▪ Control dust with water or calcium chloride application as needed ▪ Use hardened/graveled surfaces where practical ▪ Reduce travel speed ▪ Use large haul vehicles to minimize trip frequency, if available/practical ▪ Whenever possible, use conveyor belt to transport rock from the pit to the waste rock pile ▪ Moisten material on the conveyor belt as required ▪ Fit tractor trailers with tarp covers ▪ Wash equipment as required to prevent tracking of site materials onto local roads ▪ Locate stockpiles to minimize wind erosion (*e.g.*, downwind of forested area) ▪ Stabilize stockpiles to minimize/prevent wind erosion ▪ Maintain a treed or vegetative buffer along the perimeter of the site ▪ Ensure provincial particulate emissions are met ▪ Monitor particulate emissions regularly
Noise	▪ Comply with provincial noise guidelines ▪ Maintain a 30 m buffer between the extent of the operation and the property boundary, preferably treed ▪ Limit operating hours to12 per day, 5 days per week if site is located within 500 m of residences (unless otherwise agreed) ▪ Maintain equipment and trucks in good working order ▪ Monitor noise levels at the property boundary and/or nearest receptor regularly
Groundwater	▪ Conduct pre-development well survey ▪ Replace any water supply (temporarily of permanently) that is impacted by the development (*i.e.*, drill a new well, connect to existing water supply system)
Acid Rock Drainage	▪ Analyze waste rock to confirm acid generation and consumption potential ▪ Treat effluent with lime to neutralize acidity ▪ Monitor effluent to ensure treatment is sufficient and effective to meet provincial/federal requirements
Aesthetics	▪ Maintain treed/vegetative buffer between development and receptors/roads whenever possible ▪ Vegetate stockpiles used as visual/noise barriers
Reclamation	▪ Strip and preserve topsoil ▪ Develop the site in phases to facilitate reclamation (*i.e.*, progressive reclamation ▪ Identify end land use in consultation with NSDNR, NSEL affected landowners (where applicable) and community liaison committee ▪ Post reclamation bond ▪ Remove and properly dispose of any infrastructure ▪ Re-establish original contours and drainage pattern ▪ Allow for settlement of backfilled areas ▪ Bury acid generating material within the excavation ▪ Replace topsoil and establish stable vegetative cover (seeding/hydroseeding) ▪ Apply fertilizer and other soil amendments as required ▪ Monitor the site to ensure sustainability
Community Relations	▪ Establish a community liaison committee ▪ Ongoing consultation with government agencies

A vegetation assessment of surface mining reclamation undertaken in CBRM has been developed is support of this cumulative effects study (Appendix E) to address the high level of concern expressed by community members regarding poorly reclaimed areas from past surface mining activities. The importance of proper site reclamation is also recognized as a critical means to reduce long-term cumulative environmental effects on a variety of valued environmental and socio-economic components. This vegetation assessment also contains a number of best management practices as well as recommendations for research and development of evaluation tools.

4.2 Other Jurisdictions

4.2.1 Canadian Jurisdictions

In support of this assessment, other jurisdictions in Canada with relatively large surface coal mine operations, namely Saskatchewan, Alberta, and British Columbia (BC), were contacted. Contact was made with environment or resource officials to identify common industry practices in these regions in an effort to identify opportunities for improvement for the industry in Nova Scotia.

Similar to the regulatory process in Nova Scotia, provincial environment departments issue permits and approvals for mine operations while another department is responsible for resource development. Also, it was found that today's environmental management practices in Nova Scotia do not vary significantly from those in other jurisdictions; however, issues may vary slightly (*e.g.*, acid drainage is generally not an issue of concern in the prairies).

In these other Canadian jurisdictions, end land use is determined at the time of the application (*i.e.*, when EA is submitted). It has become a standard in Alberta and BC that reclamation planning ensure that the land be returned to an equivalent land capability (*i.e.*, productive agricultural land be returned to its pre-development state). End land use other than equivalent land capability (as agreed to by the landowner, where applicable) is identified as part of the application to create certainty for all parties involved. Saskatchewan also follows a similar approach to reclamation planning.

Reclamation planning includes an operational phase as well as a final/end land use reclamation plan. Operators are required to monitor and report on progressive reclamation activities on a regular basis to environment officials.

As is the case in Nova Scotia, financial security is posted to cover decommissioning and reclamation of the operation. In Alberta, progressive reclamation allows for return of the security bond on a pro-rated basis.

4.2.2 United States

The following are Best Management Practices (BMPs) for surface coal mining based on U.S. *Surface Mining Control and Reclamation Act* of 1977 (SMRCA) as administered by the Office of Surface Mining (OSM) within the U.S. Department of Interior.

Regulation of coal mining in the U.S. provides a relevant basis for identification of industry best management practices in surface and underground mining of coal. The regulations have been developed over the past 25 years, following the implementation of SMCRA. SMCRA was passed by the U.S. Congress to specifically address issues with the mining of coal and more specifically the effective reclamation of the mined land areas. SMCRA is focused on:

- protection of the rights of citizens;
- protection of the environment;
- limiting mining where reclamation is not technically and economically feasible; and
- providing for proper and timely reclamation of coal mining sites.

Development of the regulations and the associated guidance documents for implementation has been an on going process since the early 1980's and the resulting regulations have been tested in numerous court cases. Implementation of the regulations is through the OSM which also has an international outreach function. Therefore, the U.S. regulatory program has been exported to developing coal producing countries such as Indonesia.

BMPs that have been developed to meet the regulatory requirements are focused on the effective management of mining operations such that final reclamation and closure can be achieved. Fundamental aspects of the OSM regulatory process includes:

- baseline characterization of the mine disturbance area;
- impact and mitigation analysis to establish the technical and economic feasibility of reclamation of the mine disturbance to an equivalent or better landuse as the pre-mining condition, including returning the surface mined land to "approximate original ground contours (AOC)";
- minimization of the area of active mining to the minimum area practicable and concurrent reclamation to limit the area of mining disturbance at any one time;
- renewal of permits on a five year basis with a mid-term review to confirm mining operations are following the approved mining and reclamation plan;
- periodic reporting of environmental performance by the operator which is confirmed by site inspections by the regulators;

- maintaining a performance bond or other financial surety by the regulatory agency which is of sufficient value to allow the agency to complete reclamation of the mining disturbance at any time, if the mine operator becomes financially insolvent or if the mine permit is rescinded due to non-compliance; and
- providing for retention of the financial surety for a defined post-reclamation performance period to demonstrate the reclamation has provided a sustainable ecosystem.

In general, these BMPs address similar issues and activities as mitigatve measures used in Nova Scotia and other Canadian jurisdictions. In some cases, more detail and requirements are provided (*e.g.*, acid drainage), and different permitting requirements apply (*e.g.*, five year renewal with mid term review).

Best Management Practices for Surface Coal Development

Table 4.2 provides a compilation of best management practices based on regulations prescribed by the U.S. Office of Surface Mining. Please refer to Section 7.2 for a list of references used to develop these best management practices. Some of these BMPs are similar to mitigative measures and management practices currently applied in Nova Scotia (Table 4.1). Most of the BMPs are potentially applicable to Nova Scotia surface coal developments, but their specific applicability depends on many factors including, but not limited to: the size and type of development; geologic conditions; proximity to developed or ecologically sensitive areas; and community concern. The use or requirement for certain BMPs must be made on a project specific basis in the context of project specific environmental assessment.

TABLE 4.2 Summary of Best Management Practices for Surface Coal Mining

	Objectives	Best Management Practice
Dust Control	Control air emissions (primarily dust) from mining operations including drilling and blasting, haul truck operation, topsoil and overburden stockpiling and disturbed mine lands. Control impacts of air emissions (dust and methane) from shafts, slopes and vent shafts. Control air emission (dust) from material handling and processing including conveyor transfer points, stockpiles, crushers and screens.	Use equipment with appropriate emission control technology such as electric equipment, clean burning combustion engines, catalytic converters and exhaust scrubbers for drilling and blasting, loading and haulage. ▪ Topsoil removal and stockpiling ▪ Conduct operations during periods of higher soil moisture to minimize dust generation. ▪ Select equipment which minimizes dust generation such as topsoil removal using scrapers as opposed to loaders and trucks. ▪ Drilling and blasting in surface mines ▪ Use non-explosive rock breakage such as ripping for softer rock materials more susceptible to dust generation. ▪ Use delay blasting for effective rock breakage. ▪ Restrict blasting when wind conditions will convey excessive dust to offsite receptors. ▪ In extreme cases, application of water to area of blast immediately before blasting. ▪ Haul truck operations ▪ Design mine plans to minimize truck haul distances. ▪ Size mining equipment to optimize number of haul trips per day. ▪ Construct suitable mine haul roads with low dust generating surfacing materials. ▪ Implement dust suppression measures such as application water, including application of dust palliatives (wetting agents like magnesium chloride, polymer additives or organic bonding materials) to increase the effectiveness of water in dust suppression. ▪ Material stockpiling ▪ Minimize drop heights when stockpiling materials. ▪ Select stockpile locations for optimal performance relative to offsite dust emissions (prevailing wind directions and location of receptors). ▪ Apply surfactants, polymeric films, electrolytes or emulsions with water to crust or bond surfaces. ▪ Apply temporary erosion covers (geosynthetics, rock mulch, asphalt emulsion and mulch, etc.) to stockpiles of highly erodible materials. ▪ Seed and mulch intermediate term stockpiles such as topsoil to establish interim vegetative cover. ▪ Disturbed land source areas ▪ Minimize area of disturbed lands through effective, concurrent land reclamation and revegetation. ▪ Material handling sources ▪ Control drop heights at conveyor transfer points or discharges to stockpiles. ▪ Install water sprays, foggers or atomizers at all transfer points and at crushers and screen plants. ▪ Enclose transfer points, crushers and screening plants with dust collection in baghouses, gravitational settling chambers, cyclones, wet scrubbers, electrostatic precipitators, oil media filters, etc.
Blasting	Control of ground vibrations that can cause structure damage Control of air-overpressure (air blast)	▪ Conduct pre-blasting surveys (preferably by independent third-party engineer working under contract to project operator) of structures within the area of impact of mining to asses both current structural conditions as well as sensitivity to blasting effects. ▪ Advise local residents about blasting effects relative to the human sensitivity to vibrations and low frequency sound as compared to levels that induce damage in structures and review results of pre-blast structure surveys with property owners. ▪ Define complaint/grievance procedures for citizens to address concerns to mine operator and regulatory agency. ▪ Develop site specific blasting criteria to limit the amount (weight) of explosives detonated during each incremental delay within the blasting sequence to control ground vibration and air over pressure levels. This results in a charge weight per delay versus distance to closest structure relationship that is used in design of the blasting sequence. ▪ Perform blasting near mid-day to minimize impacts to local residents. ▪ Perform blast monitoring to measure ground vibration (measured as peak particle velocity) and air overpressure using automated blast monitoring equipment with data analysis by independent third party. ▪ Provide quarterly reports of blast monitoring.

TABLE 4.2 Summary of Best Management Practices for Surface Coal Mining

	Objectives	Best Management Practice
Acid Rock Drainage	Control environmental impacts to surface and ground water resources due to exposure of sulfide bearing materials during mining that have the potential to generate acid upon oxidation. Identify potential costs associated with mine related acid drainage for use in establishing financial surety requirements.	Characterize acid generation potential of overburden materials to be exposed during mining Sample entire overburden column and obtain a statistically representative number of samples of each significant material type. Conduct static testing (Acid/Base Accounting) to determine acid generation potential as compared to neutralization potential. Conduct kinetic testing (leach columns or humidity cell) on potentially acid generating materials to determine rate of oxidation and neutralization and toxicity of resulting leachate. Develop mine plan to minimize amount of reactive material to be exposed and the time the reactive material is exposed to oxidation. Define preventative/mitigation measures to be implemented to control oxidation during reclamation to assure all toxic-forming materials are treated, buried and compacted, or otherwise disposed of in a manner designed to prevent contamination of ground or surface water. Control of surface water to route drainage away from reactive materials, provide prompt removal of water from mine pits that are in contact with reactive materials, and construct underdrains to route water away from contact with reactive materials. Selective placement of reactive materials to minimize contact with air and water, with non-toxic cover material (typically a minimum of 1.2 meters). Placement of reactive materials below permanent water level to preclude exposure to oxidation. Application of bactericides to inhibit iron and sulfur oxidizing bacteria. Addition of alkaline agents to increase neutralization potential. Application of rock phosphate to inhibit pyrite oxidation. Encapsulate or isolate with physical barriers such as clay liners, fly-ash or cement amended soils, or geomembranes. Estimate cost of any additional reworking of preventative/mitigation measures that could possibly be required after reclamation is completed for use in defining required financial surety requirements to be retained for a post-closure reclamation demonstration period. Define preventative/mitigation measures to control any impacts to surface or ground water should acid generation occur prior to final completion of a post-closure reclamation performance period. Installation of collection system for any seepage resulting from mine spoil or refuse disposal areas. Installation of groundwater collection or control systems to manage impacted groundwater. Installation of passive water treatment facilities to neutralize acidic water and reduce metal content. Installation of active water treatment facilities to neutralize acidic water and reduce metal content. Estimate cost of any additional preventative/mitigation measures for surface or ground water impact control that could possibly be required after reclamation is completed for use in defining required financial surety requirements to be retained for a post-closure reclamation demonstration period. Define a post-closure surveillance and monitoring period that is of sufficient duration to demonstrate acid mine drainage will not develop in the long-term and maintain sufficient financial surety to address any required reclamation mitigation measures. Do not permit any mining operations for which it cannot be demonstrated that long-term active water treatment will not be required to control acid mine drainage.
Surface and Ground Water	Characterize the pre-mining hydrologic conditions (quantity and quality of surface and ground water). Predict impacts of mining disturbances. Design mitigation measures to reduce mining disturbance related impacts to acceptable levels.	Characterization of hydrologic conditions Assemble published baseline hydrologic and geologic data for site. Installation of surface water monitoring system. Rainfall measurement Streamflow measurement Surface water quality sampling and analysis (on a rainfall event basis is preferred) Total suspended solids Total dissolved solids Oil and Grease Dissolved Oxygen (field) pH Conductivity Temperature (field) Ammonia (NH3) Arsenic (As) Bicarbonate (HCO3) Cadmium (Cd) Calcium (Ca) Carbonate (CO3) Chloride (Cl) Copper (Cu)

TABLE 4.2 Summary of Best Management Practices for Surface Coal Mining

	Objectives	Best Management Practice
		▪ Iron (Fe) ▪ Lead (Pb) ▪ Magnesium (Mg) ▪ Mercury (Hg) ▪ Nitrate-Nitrites (NO4 – NO3) ▪ Phosphate (P) ▪ Selenium (Se) ▪ Sodium (Na) ▪ Sulfates ▪ Zinc (Zn) ▪ Ground water quality sampling and analysis (on a quarterly basis is preferred) ▪ Total dissolved solids ▪ pH (field) ▪ Conductivity (field) ▪ Temperature (field) ▪ Ammonia (NH3) ▪ Arsenic (As) ▪ Bicarbonate (HCO3) ▪ Cadmium (Cd) ▪ Calcium (Ca) ▪ Carbonate (CO3) ▪ Chloride (Cl) ▪ Iron (Fe) ▪ Magnesium (Mg) ▪ Mercury (Hg) ▪ Nitrate-Nitrites (NO4 – NO3) ▪ Phosphate (P) ▪ Selenium (Se) ▪ Sodium (Na) ▪ Sulfates ▪ Zinc (Zn) Predict mining disturbance related impacts ▪ Alteration of surface water drainage patterns ▪ Sediment generation ▪ Erosion from mine disturbance areas. ▪ Increased erosion in channels due to alteration of surface water drainage patterns. ▪ Chemical changes in sediment due to mixing of overburden materials. ▪ Acid mine drainage potential ▪ Underground mine or surface pit groundwater pumpage impacts ▪ Impacts to water supply (ground or surface water) ▪ Impacts of waste water from coal processing plants or seepage from coarse and fine coal refuse disposal. Design mitigation measures to control impacts ▪ Reclamation planning to provide hydrologic and geomorphically suitable drainage. ▪ Implement best management practices for sediment control measures and reclamation-revegetation measures. ▪ Mitigate Acid Rock Drainage using best management practices. ▪ Implement groundwater re-injection/recharge to control mine dewatering impacts. ▪ Install seepage control and containment provisions to control impacts from preparation plants and refuse disposal areas. Do not permit mines with significant potential for unacceptable hydrologic impacts

TABLE 4.2 Summary of Best Management Practices for Surface Coal Mining

	Objectives	Best Management Practice
Erosion and Sediment Management	Manage impacts of mining on quantity and quality of water discharged from site. Prevent off-site material damage. Manage impacts of mining on geomorphic stability and erosion of channels, streams, and rivers in mine influence areas.	▪ Mine planning to minimize surface disturbance areas to the maximum extent practicable and incorporate concurrent reclamation. ▪ Surface water control planning ▪ Definition of discharge water quality and quantity limits based on assessment of the sensitivity of the receiving environment, based on environmental impact analysis. ▪ Identification of areas with high potential for soil erosion and focus efforts on sediment control from same. ▪ Definition of design storm event for which surface water impacts and sediment discharge must be controlled (1 in 10 year to 1 in 25 year recurrence interval is typical). ▪ Managing all runoff and sediment within the minesite, designing to only discharge water meeting the relevant discharge standards. ▪ Preparing a hydrologic model using technically appropriate methodology (SEDCAD modeling software for example) to analyze surface water discharge and sediment yield for each phase of mine life. ▪ Location and sizing of sediment control structures and best management practice features as necessary to control peak flows and sediment content to acceptable limits for discharge off the mine site. ▪ Design surface water channels for the final reclamation topography to be geomorphically stable to control long-term erosion. ▪ Evaluate interface of permanent, post-reclamation surface water management with facilities required during mining to assure continuous control of surface water flow and sediment from initial ground disturbance through final reclamation of entire mine area. ▪ Evaluate maintenance requirements for channel and sediment structure maintenance. ▪ Estimate costs for reclamation and post-reclamation phase for financial surety planning. ▪ Installation and management of surface water and sediment control structures and facilities in accordance with surface water control plan ▪ Silt fencing ▪ Low geotextile fabric fence formed by a fabric held vertically with short fence posts. ▪ Fencing is placed across sloping area of land. ▪ Reduces flow velocity of overland water flow and filters sediment without impounding water. ▪ Strawbale check dams ▪ Detention/filtration structures formed by placing small agricultural bales end to end in rows across sloping ground. Bales are held in place by metal or wooden stakes driven through bales into ground. ▪ Reduces flow velocity of overland and shallow channel flow and filters sediment with limited impoundment of water. ▪ Temporary structures which can be easily added or removed as needed. ▪ Rock check dams ▪ Low, porous loose-rock embankments intended to slow velocity but not impound water. ▪ Used in channelized flow to reduce velocity or can be placed parallel to ground slope in areas of converging overland flow. ▪ Sediment trapping efficiency can be improved by incorporating geotextile filter fabric in design. ▪ Geotextile and rock basket gabion structures ▪ Detention structures formed by placing cobble to small size boulder rock in rectangular wire-mesh boxes with geotextile filter fabric for increased sediment trapping. ▪ Used in high velocity, high volume or long flow duration situations. ▪ Can be used to construct check dams, channel drop structures, spillways, outlet aprons, or channel erosion protection. ▪ Sedimentation basins or ponds ▪ Traditional means of peak discharge and sediment control. ▪ Basin sizing is dependent on stormwater inflow volume and sediment settling characteristics. ▪ Basin shape (length to width) and depth must be designed to provide both sediment settling time and storage capacity. ▪ Outfall design should allow for passive operation to allow controlled discharge through a normal discharge system under the design precipitation event without operator intervention. ▪ Emergency spillway system is necessary to insure basin or pond will not overtop and breach leading to catastrophic failure under precipitation events exceeding the design event. ▪ Efficiencies can be improved with the use of interior baffles and addition of flocculation agents. ▪ Vegetative filters or biofilters ▪ Grass strips used for sediment trapping for overland flows. ▪ Grass density (stems per unit area) must be high and grass species must be able to resist overland flow forces with bending to the ground. ▪ Suitable for small drainage areas, with limited sediment yield. ▪ Can be used as control measure along haulroads, railways and as a final "polishing" before overland flows discharge to stream channels. ▪ Increased effectiveness by using in combination with silt fences.

TABLE 4.2 Summary of Best Management Practices for Surface Coal Mining

	Objectives	Best Management Practice
		▪ Surface water quality monitoring ▪ Necessary to allow confirmation of performance of best management practices as well as document compliance with established discharge water quality standards. ▪ Flow measurements and water quality sampling and analysis to be precipitation event based to assure measurement of peak effects. ▪ Reporting of monitoring results to regulatory agency to demonstrate compliance with operational criteria.
Noise	Control noise generated by project to levels acceptable to receptors in surrounding area.	Complete noise surveys and predictive modeling to assess impacts. Select equipment with appropriate mufflers and noise suppression equipment. Conduct high noise generating operations such as drilling, blasting and crushing during daylight hours. Install sound suppression berms or barriers if noise can not be adequately mitigated.
Traffic	Conduct operations at mine to minimize impacts to traffic on roads and highways surrounding mining operations.	Conduct analysis of capacity of transportation network that will be impacted by mining operations and coal transport. Assess relative increase in traffic due to mining operations (employees, vendors and suppliers and coal haulage). Develop mitigation measures if capacity is exceeded ▪ Modify schedules to allow mine traffic in times of lower roadway usage. ▪ Require project sponsor to improve capacity of roadways through signalization, adding turning or passing lanes, increasing lanes or constructing bypasses. ▪ Install alternative means of transporting coal such as rail haulage or conveyors to points that bulk material movement can occur to reduce local impacts.
Reclamation	Return land to a equivalent or higher landuse as existed prior to mining.	Prepare reclamation and revegetation plan prior to commencing mining which demonstrates the feasibility of successfully reclaiming mined land, with a detailed estimate of costs. Mine plans should minimize the amount of disturbance to the minimum practical at all times in the mine life and include progressive reclamation. Require periodic updates to reclamation plan over the life of mining to assure adequate financial surety is maintained at all times. Topsoil salvage and management ▪ Identification of topsoil and topsoil substitute material in mine disturbance area. ▪ Analyze topsoil requirements for reclamation work and confirm adequate material is available within mine area or identify areas to borrow sufficient suitable material. ▪ Prepare and implement topsoil and topsoil substitute salvage and stockpiling plan ▪ Define depths and limits of various materials. ▪ Identify stockpile locations. ▪ Keep all traffic off undisturbed topsoil areas prior to salvage. ▪ Relocate topsoil directly from the salvage area to the reclamation area to the extent possible to maintain the topsoil as "live". ▪ Select appropriate equipment for topsoil salvage and stockpiling, which is commonly scrapers to control dust and allow selective removal of only material meeting the specifications of select growth materials. ▪ Construct perimeter ditch and sediment containment facilities around stockpile prior to beginning placing material and mark location with signs. ▪ Segregate topsoil from other growth media or topsoil substitute materials. ▪ Maintain stockpiles in discrete locations with sideslopes not exceeding 5 to 1 (horizontal to vertical), with final surface scarified parallel to slope to aid in controlling erosion. ▪ Revegetate all stockpiles which will be in place for longer than 2 months. ▪ Landform development and grading ▪ Define final mine site topography as part of the reclamation planning process and place mine spoil to the general lines and grade of the final topography. Landform stability (slope stability and erosional stability) is a critical element in reclamation of mined lands. Slope areas and drainage patterns should, in general, conform to the pre-mining topography. ▪ Selectively place potentially acid generating materials in accordance with best management practices for acid mine drainage control. ▪ Selectively place any materials which would be toxic or otherwise detrimental to plant growth as required for revegetation. ▪ Place topsoil or topsoil substitute materials to the depths required to facilitate revegetation. ▪ Control traffic on all areas over which topsoil has been placed to limit compaction prior to revegetation. ▪ Erosion Control ▪ Implement erosion control best management practices during all phases of reclamation and revegetation with ongoing inspection and monitoring to confirm satisfactory performance.

TABLE 4.2 Summary of Best Management Practices for Surface Coal Mining

	Objectives	Best Management Practice
		Revegetation Define plant species and diversity to meet the defined post-mining landuse. Define and apply necessary soil amendments. Seed or plant reclamation area with appropriate plant species to provide a self-sustaining ecosystem. This may require an initial starter cover to be planted for stabilization of the surface, followed by establishment of the permanent vegetative cover. Apply mulches or erosion control fabrics as necessary to control erosion until vegetation is established. Install appropriate fencing or other controls to restrict domestic animals and wildlife from reclaimed areas. Post-reclamation performance monitoring Define minimum required period for demonstration of sustainability of reclaimed mined lands (typically a minimum of 5 years). Perform periodic (quarterly to semi-annual) inspections to verify erosion is controlled and plant propagation is proceeding. Any significant re-working of reclaimed land will restart performance monitoring period. Define criteria for incremental release of financial surety as reclamation success is demonstrated.
Subsidence	Control surface disturbance and structural damage resulting from subsidence from underground coal mining.	Complete a pre-subsidence survey to identify structures, water supplies (drinking, domestic or residential) or renewable resources lands that could be impacted by a planned or unplanned subsidence event due to proposed underground mining. Design underground mine extraction ratio (room and pillar) or longwall panel layout to control subsidence occurrences and magnitude. Prepare a subsidence control plan to address risk of impacts to facilities or resources Identify method of coal removal. Provide map of underground workings and sequence of coal extraction. Identify planned subsidence events. Provide analysis of subsidence potential (planned and unplanned) and resulting impacts to surface structures and resources. Define observation and monitoring program to be implemented during mining. Establish mitigation and response measures to control subsidence Backfilling mine openings. Leave supporting pillars of coal. Do not mine under critical or sensitive areas. Establish estimate of financial impacts to surface landowners due to planned or potential subsidence impacts. Establish procedures for landowners to present claims for damages. Provide financial surety to address subsidence impacts.

Note: Best management practices (BMPs) contained in this table are broadly applicable to a wide range of surface coal developments. Some BMPs will not be applicable or appropriate for all projects in Nova Scotia. Application of specific BMPs will depend on a variety of factors such as: geology, proximity to receptors, characteristics of the receiving environment and specific requirements identified in project specific EAs.

5.0 CUMULATIVE EFFECTS ASSESSMENT

5.1 Methodology

Environmental assessment (EA) is a systematic process for analyzing and evaluating the potential environmental effects of proposed development activities, and is an important means of incorporating environmental considerations into decision-making. Under the Nova Scotia *Environment Act*, environmental assessment is defined as a process by which the environmental effects of an undertaking are predicted and evaluated and a subsequent decision is made on the acceptability of the undertaking.

Although the Nova Scotia *Environment Act* does not explicitly include cumulative environmental effects within its definition of an environmental effect, good EA practice requires consideration of potential incremental or possibly synergistic effects that may result from a proposed project in combination with other past and present human activities. Provincial legislation affords some ability for the Minister to consider cumulative effects under Section 12(g) of the Environmental Assessment Regulations in decision making through the review of “planned or existing land use in the area of the undertaking”.

In the absence of clear direction on methodology for cumulative effects assessment at the provincial level, the study team has referred to guidance on cumulative effects assessment at the federal level under the *Canadian Environmental Assessment Act* (*CEAA)*. The methodology used to conduct this assessment is consistent with cumulative effects assessment, as directed under *CEAA*.

CEAA specifically requires the consideration of the cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out. An important distinction is the need to consider reasonably foreseeable future projects which creates the need to first determine what other projects or activities are to be considered. A Joint Review Panel for the Express Pipeline Project in Alberta (National Energy Board and Canadian Environmental Assessment Agency 1996) determined that certain requirements must be met for the Panel to consider cumulative environmental effects:

- there must be an environmental effect of the Project being proposed;
- the environmental effect must be demonstrated to operate cumulatively with the environmental effects from other projects or activities; and
- it must be known that the other projects or activities have been, or will be, carried out and are not hypothetical.

Furthermore, the Joint Panel Review indicated that it is an additional requirement that the cumulative environmental effect is likely to occur, that is, there must be some probability, rather than a mere possibility, that the cumulative environmental effect will occur.

In this case, addressing cumulative effects assessment on a project-by-project basis is not possible since the level of detail required to complete an effective assessment of potential future surface mining projects is not available at this time. A regional EA approach, as outlined for strategic environmental assessment in *CEAA* is more similar to the type of study that is considered feasible in this case. In the case of regional EAs, specific sectoral activities can be considered in the context of the regional environmental setting and resource use, by examining a broad study area and identifying the full range of past, present, and/or future projects, activities, and environmental trends affecting the region of interest. This approach enables consideration of potential cumulative environmental effects and of development thresholds compatible with the carrying capacity of the environment.

The specific approach and methodology used are based on accepted environmental assessment practice, focusing on environmental and socio-economic issues of greatest concern. Assessing all of the potential issues associated with a proposed undertaking is impractical, if not impossible (Beanlands and Duinker 1983). It is therefore generally acknowledged that an environmental assessment should focus on those components of the environment that are valued by society and/or serve as indicators for environmental change. These components are known as Valued Environmental Components (VECs). The cumulative effects assessment evaluates potential effects with regard to each VEC on a regional basis.

As discussed in the Cumulative Effects Assessment Practitioner's Guide (CEA Agency 1999), a key component of cumulative effects assessment is the determination of the regional context for each VEC. The methodology applied to this assessment has considered the regional context for each VEC to identify potential cumulative effects with other projects and activities and in consideration of the regional distribution of the VECs.

A focused environmental assessment requires a process of scoping to define the components and activities that are to be considered in the assessment, to identify the key issues and to set the spatial and temporal boundaries of the assessment. The following sections provide more information on the scoping and methodology involved in this assessment.

In the early stages of the assessment a cumulative effects assessment scoping exercise was conducted to identify past, present or likely future projects that might interact cumulatively with the Project. Past projects or activities potentially affecting VECs have been considered in the description of existing conditions as applicable for each VEC. Table 5.1 outlines each project/activity identified for consideration in the cumulative effects assessment for the four respective resource blocks. This has been done only on a very general basis for this study and/or given readily available and public information accessed by the study team. This scoping and the resulting assessment is not considered exhaustive and it is appreciated that additional projects and/or activities may be present that could create cumulative effects with surface coal mining. A more detailed and comprehensive scoping of other project and activities and their cumulative effects can occur within the context of a project specific assessment.

TABLE 5.1 Project Activities Considered for Potential Environmental Interactions with Surface Coal Mining

Project Activity	Status (past, present or future)
Point Aconi power plant	Past, Present, Future
Prince Mine Site	Past
Thomas Brogan and Sons Construction Limited (surface mining, Point Aconi – Phase 3)	Future
Greenhills Development	Future
Halfway Road (Tobin Road)	Past, Present, Future
Underground coal mining	Past, Present, Future
Illegal/bootleg mining	Past
Mixed farming	Past, Present, Future
Sewage Lagoons (domestic sewage)	Past, Present, Future
Forestry	Past, Present, Future
Pits and Quarries	Past, Present, Future
Urban/residential development	Past, Present, Future
Dams	Past, Present, Future
Commercial Fishery	Past, Present, Future

For the purposes of this assessment, it has been assumed that the existing status or condition of each VEC reflects the influence of other past and current projects and activities occurring within or outside of the assessment area. The assessment has therefore integrated the cumulative effects of these ongoing projects and activities in a general way. The requirement to consider only likely (*i.e.*, approved) projects for consideration of cumulative effects has been expanded here to include some future coal mining projects for which regulatory applications have been filed (*e.g.*, Pioneer at Point Aconi) and some which are hypothetical though considered to be reasonable as development scenarios (See Section 5.3).

5.2 Scope and VEC Selection

This cumulative effects assessment involves an evaluation of surface coal mining activities in CBRM with a focus on four claim blocks of the Sydney coalfield: Point Aconi; Broughton, Boularderie Island; and Birch Grove.

5.2.1 VEC Identification

The scope of this cumulative effects assessment has been determined based on regulatory and stakeholder consultations, the professional judgement and expert knowledge of the study team, and readily available and public existing information on each of the four claim blocks. Table 5.2 shows the components recommended for consideration.

TABLE 5.2 Scoping of VECs

Component	Scoping Considerations	VEC
	Biophysical Environment	
Geology	Geology, in itself, is not a valued environmental component. Geological features of the site including mapping are presented in the discussion of effects on groundwater.	Water Resources
Surface Water	Activities may interact with surface water on-site. Surface water impacts were identified as issues of concern during public consultation. Hydrological conditions may be affected including potential impacts on water quantity and quality, and fish and fish habitat. Potable surface water supply issues are included in the potential effects on water resources.	Fish and Fish Habitat Water Resources
Groundwater	Surface mining activities will interact with groundwater resources. Impacts to domestic wells were identified as an issue of concern during public consultation. Impacts on groundwater quality and quantity, with an emphasis on domestic well impacts are addressed.	Water Resources
Wetlands	Wetlands are valued resources, protected by the Nova Scotia *Environment Act* and Regulations.	Terrestrial Environment
Flora and Fauna Species and Habitat	Projects will result in habitat loss and noise disturbance to wildlife. Rare species are protected by the Nova Scotia *Endangered Species Act* and the federal *Species at Risk Act*. Migratory birds are protected by the *Migratory Birds Convention Act*.	Terrestrial Environment
Fish and Fish Habitat	Fish and fish habitat are protected by the federal *Fisheries Act*.	Fish and Fish Habitat
Atmospheric Conditions/Air Quality	Project activities will result in release of air emissions (particularly dust). Dust was also identified as a concern during public consultation. Airborne particulates are regulated under the Nova Scotia Air Quality Regulations.	Atmospheric Environment
Noise	Project activities will result in noise emissions (*e.g.*, blasting, machinery, trucking). Noise was also identified as a concern during public consultation.	Atmospheric Environment
	Socio-economic Conditions	
Economy	Project activities may have an effect on local labour resources and the local economy. The local economy is a fundamental socio-economic determinant.	Labour and Economy
Land Use and Value	Projects may interact with surrounding land uses including residential and recreational land use. Impacts on land use were identified as a concern during public consultation.	Land Use
Transportation	Transportation infrastructure is important to the public living near and/or using the roads in the area, as is the safe transportation of equipment to and coal from the sites.	Transportation Infrastructure
Recreation and Tourism	Project activities could affect existing or planned recreation or tourism development.	Land Use

TABLE 5.2 Scoping of VECs

Component	Scoping Considerations	VEC
Human Health	Human health is a component of the environment that relates to the health and safety of the general public. Potential community health impacts from Project air emissions are addressed (in relation to guideline levels) under the Atmospheric Environment VEC.	Human Health and Safety Atmospheric Environment
Aboriginal Land and Resource Use	Project activities could affect traditional use of lands and resources by Aboriginal Peoples.	Land Use

5.2.2 Spatial and Temporal Boundaries

Boundaries provide a meaningful and manageable focus for environmental assessment. Temporal and spatial boundaries encompass those periods and areas within which the VECs are likely to interact with, or be influenced by the activities being assessed. Spatial boundaries for this assessment are generally limited to the resource blocks and surrounding areas unless other wise noted. Temporal boundaries are generally limited to the duration of, and for a period of time after, the activities, which in this case includes the duration of the Project activities, including reclamation and decommissioning activities.

Spatial and temporal boundaries for each VEC are included in Table 5.3. Spatial and temporal boundaries take on particular significance in the context of cumulative effects assessment in that measurable spatial and temporal overlap between projects and activities is required for cumulative effects to take place. As indicated in Table 5.3 the spatial boundary for consideration of cumulative effects is relatively localized for certain VECs given the relatively limited spatial extent of certain coal mining project effects (*e.g.*, dust, noise), while some are truly regional (*e.g.*, terrestrial habitat), and cumulative effects can be expected.

TABLE 5.3 Assessment Boundaries and Significance Criteria

VEC	Assessment Boundaries	Significance Criteria
Atmospheric Environment (air quality and noise)	**Spatial boundaries** for the assessment of the atmospheric environment include the airshed within which sensitive receptors (*e.g.*, residential communities) could potentially experience a measurable reduction in regulated air quality parameters (*e.g.*, airborne particulates) and/or an increase in ambient noise levels. In this case, 5 km is considered a sufficient spatial boundary around individual projects. **Temporal boundaries** are continuous throughout the life of project operations including decommissioning and reclamation activities. Other temporal considerations include those times of day and seasons when industrial dust and noise could become more of a nuisance.	A **significant adverse environmental effect** with respect to air quality is defined as one that would reduce air quality, such that the level of total suspended particulate matter exceeds 120 µg/m^3 over a 24 hour averaging period or 70 µg/m^3 over an annual averaging period. These limits are specified as the 'maximum permissible ground level concentrations' under the Nova Scotia Air Quality Regulations and as the 'maximum acceptable' limits under the *Canadian Environmental Protection Act (CEPA)* Ambient Air Quality Objectives; or with respect to noise may be defined by any of the following: ▪ a noticeable change in noise level (approximately 5 dBA) which results in exceedance of the NSEL Noise Guideline levels; ▪ a noticeable change in noise level (approximately 5 dBA) above existing noise levels in areas where the guideline levels are already exceeded; or ▪ a change in noise level of approximately 10 dBA above existing noise levels in areas where the Guideline levels are not exceeded. A **positive effect** occurs when there is a predicted or expected improvement in ambient air quality and mitigative measures in the area affected by the assessed activities, or when activities result in a reduction in ambient noise level.
Terrestrial Environment	**Spatial boundaries** for the assessment of terrestrial habitat includes habitat occurring within or immediately adjacent to the proposed block boundaries such that they could be affected by the assessed activities. **Temporal boundaries** are continuous throughout the life of project operations including decommissioning and reclamation activities. Other temporal boundaries include those periods of increased sensitivity to wildlife (*e.g.*, bird breeding).	A **significant adverse environmental effect** on the terrestrial environment occurs when the population of a species is sufficiently affected to cause a decline in abundance and/or change in distribution beyond which natural recruitment would not return the population to its former level within several growing seasons or generations; and/or a net loss of wetland functions in a wetland of significant value as determined through a recognized wetland evaluation system. A **positive effect** occurs when the assessed activities help to increase species populations and/or diversity or increase the area of a sensitive environment such as a wetland.

TABLE 5.3 Assessment Boundaries and Significance Criteria

VEC	Assessment Boundaries	Significance Criteria
Fish and Fish Habitat	**Spatial boundaries** for the assessment of fish and fish habitat are based on watershed areas potentially affected by surface runoff and/or groundwater discharges from the assessed activities. **Temporal boundaries** are continuous throughout the life of project operations including decommissioning and reclamation activities. Other temporal boundaries include those times when fish and/or habitat are particularly sensitive (*e.g.*, spawning or migration).	**A significant adverse environmental effect is** one that affects fish and fish habitat physically, chemically or biologically, in quality or extent to such a degree that there is a decline in the species diversity of the habitat. Such an effect would be reflected by a decline in abundance and/or change in distribution of one or more populations of species dependent upon that habitat. Natural recruitment would not return the population(s), or any populations or species dependent upon the habitat, to their former level within several generations. A **positive effect** is defined as one that enhances the quality of surface water for aquatic life, increases species diversity and/or increases the area of valued habitat.
Water Resources	**Spatial boundaries** for the assessment of water resources are based on a combination of aquifer hydraulic properties, expected groundwater flow directions, hydraulic properties of intervening bedrock, proximity to abandoned flood mine workings in hydraulic connection with mine, well construction and the distance between the surface mining activities and wells that may be affected. The area of influence is within 500m of the surface mining block. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** on groundwater resources is defined as one in which the projects cause one or more of the following: ▪ yield from an otherwise adequate well supply decreases to the point where it is inadequate for intended use; ▪ the quality of groundwater from an otherwise adequate well supply that meet guidelines deteriorates to the point where it becomes non-potable or cannot meet the Guidelines for Canadian Drinking Water Quality (Health Canada 2003); and/or ▪ the aquifer is physically or chemically altered to the extent that interaction with local surface water results in stream flow or chemistry changes that adversely affect aquatic life or surface water supply. A **positive effect** is defined as one on which the quantity or quality of well or spring water is improved as a result of the assessed activities, such as improving drainage.

TABLE 5.3 Assessment Boundaries and Significance Criteria

VEC	Assessment Boundaries	Significance Criteria
Land Use	**Spatial boundaries** for the assessment of land use include lands within 5 km of each of the proposed four mineral rights blocks with a focus on those land uses that could be directly affected by noise or other stimulus (*e.g.*, views). **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities. Other temporal boundaries include those periods of increased land use activity (*e.g.*, summer).	A **significant adverse environmental effect** on land use occurs when a change in existing patterns and lands uses are disrupted to a widespread degree adversely affecting all or a portion of a community's use and enjoyment of the lands. This includes adverse change to a valued visual resource (generally inconsistent with existing visual context) experienced by a significant part of the viewing community such that engineering design and landscape treatment cannot mitigate the impacts. A **positive effect** may enhance a community's use and enjoyment of lands or enhance the social value of lands consistent with its intended use. This includes an improvement to the existing visual character of the environment resulting in positive viewer response.
Transportation and Infrastructure	**Spatial boundaries** for the assessment of transportation and infrastructure include transportation and infrastructure within 5 km of each of the proposed four mineral rights blocks **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** on transportation and infrastructure occurs when there is a substantial increase in the level of maintenance required for transportation infrastructure or there is a reduction in the level of safety or service currently experienced in CBRM. A **positive effect** is one that enhances infrastructure as part of the assessed activities and therefore improves the safety and efficiency of transportation.
Human Health and Public Safety	**Spatial boundaries** for the assessment of human health and public safety includes the area within 5 km of each of the proposed four mineral rights blocks. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities..	A **significant adverse environmental effect** on human health and public safety is one where serious injury (e.g., permanently disabling) or loss of life could arise and is not manageable through generally accepted mitigative measures. A **positive effect** is one that decreases the likelihood (from present conditions) that a serious injury or loss of life could arise.

TABLE 5.3 Assessment Boundaries and Significance Criteria

VEC	Assessment Boundaries	Significance Criteria
Labour and Economy	**Spatial boundaries** for the assessment of labour and economy include the area that could reasonably be affected by the potential employment, income, economic output, and labour supply impacts associated with the assessed activities. In particular this includes the CBRM. **Temporal boundaries** are continuous throughout the life of Project operations including decommissioning and reclamation activities.	A **significant adverse environmental effect** on labour and economy occurs when there are negative impacts on regional employment, incomes, and gross economic activity, negative impacts on other regional, commercial or industrial activities, or negative impacts on the regional labour supply of such magnitude and duration that the capacity of the socio-economic environment to adjust in the short-term is exceeded. A **positive effect** is one that enhances regional employment, incomes, and gross economic activity, other regional commercial or industrial activities, or the regional labour supply.

5.2.3 Existing Conditions

Existing conditions are described for each VEC. The description is restricted to a discussion of the status and characteristics of the VEC within the boundaries established for the assessment based on readily available and public information. In order to improve the focus and readability of the assessment, the description centres on aspects that are relevant to potential interactions.

5.2.4 Residual Environmental Effects Evaluation Criteria

Accepted EA practice requires that the significance of environmental effects be determined. This typically involves establishing and applying evaluation criteria for the determination of significance. Residual environmental effects rating criteria have been established based on information obtained in issues scoping, available information on the status of each VEC, and often involves the application of environmental standards, guidelines or objectives, where these are available (*i.e.*, applicable ambient air quality guidelines). As well, the CEA Agency notes that consideration of the carrying capacity, tolerance level, or assimilative capacity of the area may be helpful, even though it may not be possible to quantify these characteristics.

Guidance documents prepared by the CEA Agency (1994) list a number of criteria that should be taken into account in deciding whether adverse environmental effects are significant, including: magnitude; geographic extent; duration; frequency; reversibility; and ecological and /or socio-cultural context. These criteria have been considered in this assessment with regard to determining the significance for each VEC. Additionally, it is necessary to clearly articulate what makes an effect significant. For each VEC, a definition has been developed "significant adverse environmental effect" and "positive effect". These are included in Table 5.3. In many cases throughout this cumulative effects assessment, it is noted that the level of detail of information and/or analysis, is general and does not support a precise assessment of the significance of residual cumulative effects according to these significance criteria. These significance criteria are nevertheless considered useful to include in this study as benchmarks or thresholds to be considered as more detailed information and analysis becomes available (*e.g.*, through project specific EAs).

5.2.5 Effects Assessment and Mitigation

As noted earlier, a focused approach is used for the environmental assessment using VECs and boundaries identified in the scoping process. In its most basic terms, the effects assessment methodology is to describe project activities that could interact with the existing conditions of VECs within the relevant boundaries and to predict the resulting cumulative effects, both positive and adverse. Environmental assessment is used as a planning tool not only to identify predicted impacts, but also to design mitigative strategies to reduce adverse effects as well as propose monitoring programs where significant risk or uncertainty remains.

For each VEC, existing conditions (*i.e.*, pre-Project) are described. The description is restricted to a discussion of the status and characteristics of the VEC based on readily available and public information within the boundaries established for the assessment. Potential interactions are investigated and evaluated based on current knowledge with regard to each interaction. Effects are analyzed qualitatively, and, where possible, quantitatively, using existing knowledge, professional judgement and appropriate analytical tools.

Where applicable, mitigation measures are identified and the significance of the predicted cumulative environmental effects of the project are evaluated based on specific evaluation criteria which considers the magnitude, frequency, duration, geographical extent and reversibility of the potential effect.

The significance of residual (*i.e.*, after mitigation has been applied) cumulative effects is then determined for each VEC where possible.

5.3 Development Assumptions

The following is a description of the potential likely surface coal mine developments in CBRM. Information to support and prepare this description was gathered from a number of information sources including: environmental assessment registration documents submitted for projects in CBRM (Pioneer Coal Ltd. 2005; Pioneer Coal Ltd. 2004; Thomas Brogan & Sons Construction Ltd. 2004; John King 2000); the call for proposals for exploration, development and reclamation (NSDNR 2003); consultation with proponents and NSDNR staff; NSDNR's presentation to the community (NSDNR 2005); and consultation with stakeholders and the general public. Where specific information was not available, descriptions were based on reasonable assumptions and inferences. It is understood that potential development could exceed or be less than what is presented below. However, it is assumed that some fundamental constraints to development will limit the level of surface coal mine development such as: the location of the productive coal seams; existing land uses (e.g., residential areas); natural features (*e.g.*, waterbodies); and markets for the coal to be extracted (*i.e.*, relatively high sulphur content).

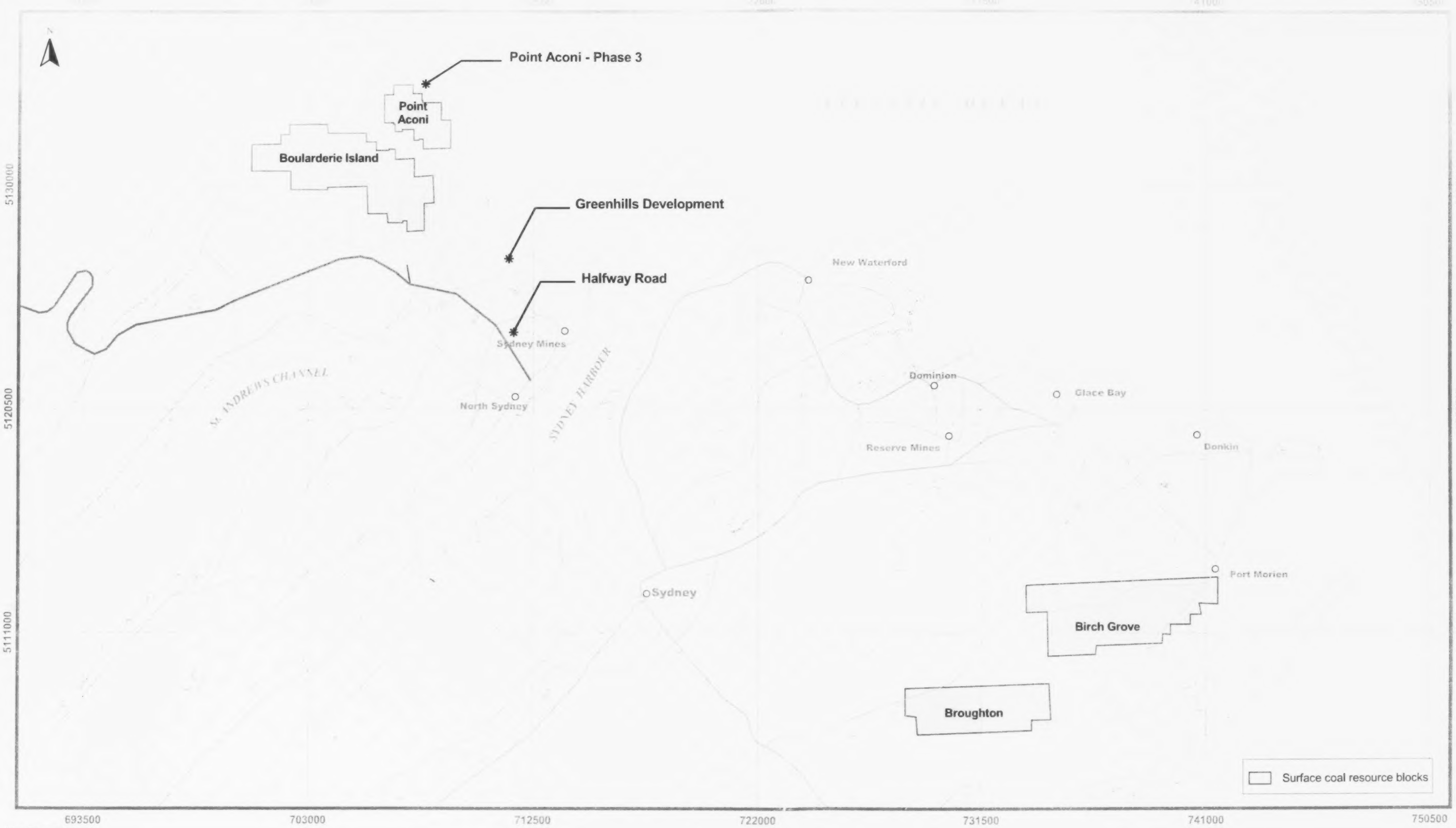
It is important to note that development cannot take place on privately owned land without landowner permission. For the purposes of this study it is assumed that, where required, landowner permission will be granted for development. Lack of landowner permission would represent a further constraint to development.

5.3.1 Tendered Resource Blocks

Point Aconi Resource Block

Pioneer Coal Ltd. was awarded sole rights to make application for the mineral rights to the coal within the boundaries of the Point Aconi Resource Block (Figure 5.1 and Figure 1 Appendix A). Since the rights were awarded, Pioneer Coal has applied for and has been granted a Special Lease for development of a surface coal mine in a portion of the block, north east of the former Prince Mine underground coal operation. Further, Pioneer Coal has submitted an EA registration document, pursuant to the Environmental Assessment Regulations, for approval to develop the site. The Minister of Environment and Labour has requested additional information regarding this submission.

The proposed project is the development of a surface coal mine and includes reclamation of a large number of bootleg pits as well as the above ground workings of the former Prince Mine. The proposed project area is approximately 85 ha with a production rate of 350,000 tonnes per year (1,350 tonnes per day) and 1.6 million tonnes over the life of the project (2005 to 2012). This relatively high production rate is attributed to the use of a highwall miner. No processing of coal at the site is proposed. Excavation may occur as deep as 30 to 45 m below the surface. It is proposed that reclamation of the site be undertaken progressively (*i.e.*, backfilling of one box cut as the next one is excavated).


N
Point Aconi - Phase 3
Point Aconi
Boularderie Island
Greenhills Development
Halfway Road
New Waterford
Sydney Mines
North Sydney
St. ANDREWS CHANNEL
SYDNEY HARBOUR
Dominion
Glace Bay
Reserve Mines
Donkin
Port Morien
Sydney
Birch Grove
Broughton
Surface coal resource blocks
5130000
5120500
5111000
693500
703000
712500
722000
731500
741000
750500

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:150,000
Project No.: NSD19669
Date: July 28, 2005

Data Source:
NSTS, 1997, scale 1:10 000
NSGC, Road Atlas, 1:500 000

Figure 5.1

Potential Future Surface Coal Mine Operations

5 0 5 10 15
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford

In addition to the typical activities described in Section 3.0, purchase of residential properties is required along Forest Lane and Point Aconi Road.

The operating schedule proposed for this project is 24 hours a day, five days a week, with occasional Saturdays, as required. It is anticipated that the mine will operate year round.

Additional information about this proposed project can be obtained from the NSEL website (http://www.gov.ns.ca/enla/ea/projects.asp).

Boularderie Island

Coastal Construction Ltd. was awarded sole rights to make application for the mineral rights for the coal within the boundaries of the Boularderie Island Resource Block (Figure 5.1 and Figure 2 Appendix A). Since the rights were awarded, Coastal Construction has applied for and has been granted a Special Licence for the exploration of coal on the eastern portion of the resource block. It is unlikely that the remainder of the block will be developed due to the level of residential development and private land ownership as well as the number of watercourses in the area. The proponent has yet to submit applications for drilling, excavation, and bulk sampling.

Within the area covered by the Special Licence, the potential surface coal mine development is uncertain; however, there are certain features within the licence area that may limit development such as: active agricultural lands, a power transmission corridor, and an important haul road. Also located just south of the licence area are Nova Scotia Power Inc. water supply well fields. As such, there is only a limited amount of land that may be mined at some point in the future.

A plausible development scenario within the Boularderie Island Resource Block could include development of the land between the haul road and the eastern boundary of the Special Licence area, avoiding the large watercourse and farmland; and also potentially development of the land between the haul road and the western boundary of the Special Licence area avoiding disruption of the power transmission corridor and farmland. As noted in Section 2.2, however, the Minister of Energy stated publicly that development would not be permitted west of the power corridor.

It is anticipated that the proponent will extract the coal using large dozers, excavators and rippers. It is likely that extraction will be over a period of five to seven years. The likely hours of operation are twelve hours per day, five to six days per week, year round. The yearly extraction volume is not known but will not likely exceed 150,000 tonnes.

There are no known opportunities for reclamation mining associated with this development.

Birch Grove Resource Block

Thomas Brogan & Sons Construction Ltd. was awarded sole rights to make application for the mineral rights for the coal within the boundaries of the Birch Grove Resource Block (Figure 5.1 and Figure 3 Appendix A). Later, NSDNR revoked this right and did not approve the application for Special Licence submitted by the proponent. As a result, the development originally proposed by the proponent will not proceed. Of the four resource blocks tendered, Birch Grove is known to have the highest quality coal (*i.e.*, lowest sulphur content) and many opportunities for reclamation mining; however, given the limited potential for development (see below), NSDNR does not anticipate that the resource block will be tendered again.

For the purpose of this study, it is assumed that there is potential for this project to proceed. The Birch Grove Resource Block contains many waterbodies and is adjacent/abutting two surface water supply areas. There is also a relatively large amount of residential development immediately adjacent to the coal seam. As such, development opportunities are limited.

Figure 3 (Appendix A) identifies four relatively small areas for potential development; two along the Gowrie Seam and two along the Spencer Seam. Development in these areas would allow for reclamation of bootleg pits, and reclamation of an old wash plant which contains stockpiles of acid producing material.

It is anticipated that the coal would be extracted using large dozers, excavators and rippers potentially extending to a depth of approximately 30 m below surface. Given the equipment to be used, it is anticipated that the production rate could be approximately 150,000 tonnes per year over a period of five to seven years. The likely hours of operation are twelve hours per day, five to six days per week, year round.

Broughton Resource Block

Pioneer Coal Ltd. was awarded sole rights to make application for the mineral rights for the coal within the boundaries of the Broughton Resource Block (Figure 5.1 and Figure 4 Appendix A). Since the rights were awarded, Pioneer Coal has applied for Special Lease for development of a surface coal mine in a portion of the block. This application is currently under review. To date, the proponent has not yet filed an environmental registration for a development in the block.

Given the limited residential development in the resource block and the orientation of the coal seams, it is reasonable to assume that a fairly significant portion of the block could be developed at some point in the future. There are also opportunities for reclamation of the surface workings associated with three former underground mines.

A reasonable development scenario within the Broughton Resource Block could include development of a 300 to 400 m wide area along the Tracy

Seam, and potentially another along the MacDonald Lake Seam. The developed area could yield a production rate of up to 350,000 tonnes per year. This relatively high production rate is considered appropriate given that the proponent has access to a highwall miner. Excavation may occur as deep as 30 to 45 m below the surface. It is likely that extraction and reclamation will be undertaken progressively (*i.e.*, backfilling of one box cut as the next one is excavated).

5.3.2 Surface Coal Mine Developments Outside of the Tendered Resource Blocks

In addition to the potential or proposed developments described above, there are a number of other likely future surface coal mines within CBRM, yet outside of the tendered resource blocks. These developments are described below with locations, indicated on Figure 5.1.

Halfway Road (Tobin Road)

Remediation mining is being considered at this location as a result of significant public concern about public safety (*i.e.*, numerous bootleg pits) as well as environmental damage (*i.e.*, acid drainage). The area, which is located near Sydney Mines, has been heavily impacted by past legal and illegal mining. The site has largely revegetated with mixed woodland. Considerable use is made of trails in the area, even though off-trail areas are heavily crop-pitted. More recently, bulk sampling has been undertaken and efforts are now being made to revegetate these areas.

When the possibility of re-mining the Halfway Road site was first introduced to the community, there was and continues to be significant opposition. A group of residents have subsequently become convinced that the area is extremely hazardous in its current state (*i.e.*, from bootleg mine openings) and are now supporting a future surface mining project in order to make the land safe and available for future community use. Together with NSDNR, they have been developing a future land use concept, including an engineered wetland to handle the existing acid rock drainage problem, and have begun discussions with possible partners.

The amount of coal remaining on site is not confirmed. As such, specific details of a potential development cannot be identified. It is likely that the project will be undertaken over a period of one to three years, with ongoing monitoring of the reclaimed area.

Point Aconi Phase 3

In December 2004, Thomas Brogan & Sons Construction Limited submitted an environmental assessment registration document (pursuant to the Environmental Assessment Regulations) for approval to extend development of the former Phase-2 Brogan Mine site, located in the northern most portion of the community of Point Aconi. The proposal is to extract 50,000 tonnes of coal over a period of one year. The proposal includes progressive reclamation with reclamation activity to be complete within one year following completion of coal recovery. Monitoring of reclamation would continue until the site is accepted by government agencies and private landowners.

The Minister of Environment and Labour requested that additional information be provided to support the application. The project is not yet approved.

Additional information about this proposed project can be obtained from the NSEL website (http://www.gov.ns.ca/enla/ea/projects.asp).

Greenhills Development

The Greenhills Surface Coal Mine project received conditional EA approval in March 2000. The project, which has not yet commenced, consists of extraction of the remaining coal resource in the crown pillar of the Florence Colliery, approximately 85,000 tonnes of coal. The footprint of the project will be approximately 11 ha (28 acres) over two development areas. Extraction will be undertaken in a series of box cuts to a depth of approximately 12 to 15 m (40 to 50 feet) using common construction equipment (*i.e.*, dozers, excavators, trucks). Backfilling and reclamation will be undertaken progressively. The project will operate ten hours a day, six days a week between April and December over a three to four year period.

Additional information on these and other sites is provided based on community consultation in Appendix D.

5.4 Biophysical Assessment

5.4.1 Atmospheric Environment

Atmospheric Environment is included as a VEC due to a concern with potential cumulative effects from surface coal mining on air quality and the acoustic environment in CBRM. Potential effects on air quality result mainly from airborne particulates generated during mining. Potential effects on the acoustic environment could result from equipment operation, vehicle movements, and blasting. Cumulative effects on this VEC could arise if air quality and noise impacts from coal mining interacts with other projects or activities to exceed regulatory limits or guidelines.

5.4.1.1 Air Quality

Existing Environment

The climate of the area is affected by cyclonic storms moving west to east, and moderated by the proximity to the ocean. Prevailing winds are from the southwest, with stronger, but less frequent winds from the northwest quadrant. Figure 5.2 is a "wind rose", or a joint windspeed-direction frequency diagram, illustrating the frequency and speed with which the wind blows from each direction. These data are for 1995-2000 from the Sydney airport, close enough to be representative of the study area. The prevailing winds cause many of the low-pressure systems, which combined with the maritime location, result in a moderately high precipitation (*i.e.*, 1300 m/year).

The existing air quality in the region is influenced by natural conditions, local point sources, distant point sources (*i.e.*, contributions from the Atlantic Provinces, central Canada and northeastern US). There are few sources of air pollution of significant size in the area proposed for surface coal mining. The Point Aconi thermal generating station and the Lingan thermal generating station are likely the two largest point sources in CBRM. Despite the presence of the two power plants in the region, air quality is consistently good in the area due to the remoteness from large urban centers, and a relatively small rural population.

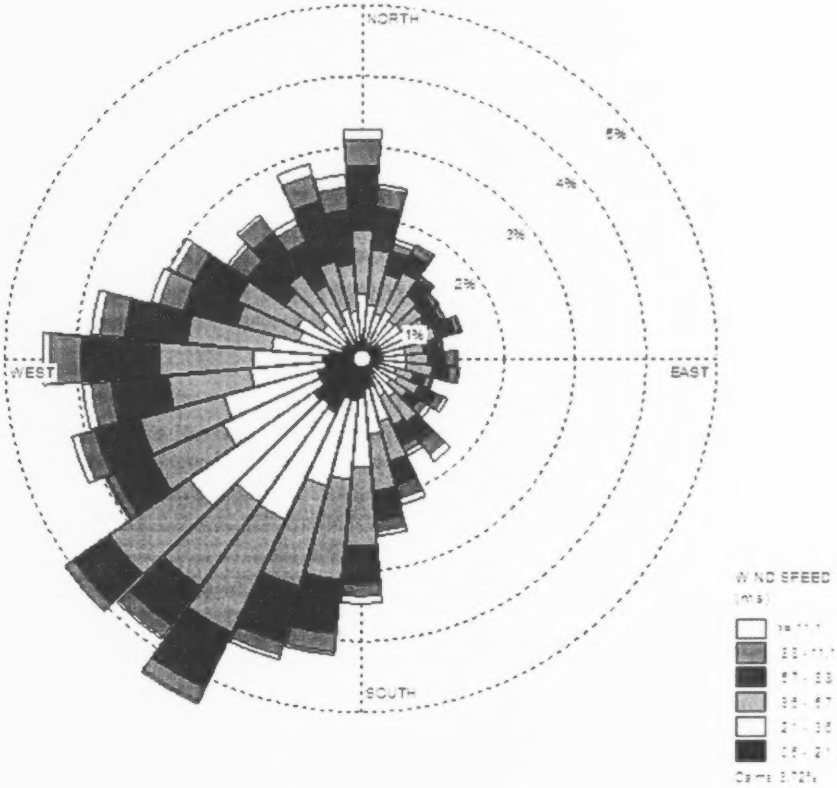


FIGURE 5.2 Average Wind Conditions Sydney Area

Development Concerns

Air quality issues associated with surface coal mining can be described under the following general categories:

- transportation of coal from the mine (particulate matter, vehicle exhaust);
- equipment movement and excavation of material at the mine site (particulate matter, vehicle exhaust);
- wind erosion of overburden and coal dusts (particulate matter); and
- methane releases from the coal bed (greenhouse gas).

In addition to these direct emissions, the ultimate use of the coal results in certain emissions (*e.g.*, $S0_2$); however these are attributed to the end-user and are not included in the scope of this assessment. It is noted however that the sulphur content of the surface coal within the four resource blocks is relatively high (3.5% to 7.1%) compared with coal from surface developments in the Stellerton area (0.8%). NSPI will typically burn coal in the range of 1.5% to 2% sulphur. Higher sulphur coal must be blended with lower sulphur coal to achieve the criteria.

Most of the emissions are characterized as fugitive emissions; that is, they are emissions that escape because controls and capture may be limited in effectiveness. Most of the concerns about mine emissions relate to fugitive particulate emissions, sometimes referred to as dust. In air quality terminology, particulate matter is defined according to the aerodynamic size and behavior of the particles.

Total Suspended Particulate Matter, or TSP is that part of particulate matter that is generally of the size range less than 44 microns, and is small enough to stay suspended by the air and travel some distance. More recently, regulators have begun to focus on material that can be inhaled and be responsible for health impacts. Particles smaller than 10 microns are able to pass by the capture mechanisms of the human sinuses and enter the lungs. Particles smaller than 2.5 microns are able to penetrate deeply into the lungs and to become trapped there.

Air quality regulations in Nova Scotia apply to TSP. Under the Canada Wide Standards initiative, standards have been proposed for the smaller size fractions and will be in place by 2010. Table 5.4 shows the regulations under the Nova Scotia *Environment Act* and the objectives under the federal *Canadian Environmental Protection Act*. The federal objectives are set as guidelines to assist in the assessment process, but do not have the same standing as the provincial regulations.

TABLE 5.4 NOVA SCOTIA Air Quality Regulations and *Canadian Environmental Protection Act* Ambient Air Quality Objectives

Pollutant and units (alternative units in brackets)	Averaging Time Period	Nova Scotia	Canada			
		Maximum Permissible Ground Level Concentration	Canada Wide Standards (pending)	Ambient Air Quality Objectives		
				Maximum Desirable	Maximum Acceptable	Maximum Tolerable
Nitrogen dioxide $\mu g/m^3$ (ppb)	1 hour	400 (213)	-	-	400 (213)	1000 (532)
	24 hour	-	-	-	200 (106)	300 (160)
	Annual	100 (53)	-	60 (32)	100 (53)	-
Sulphur dioxide $\mu g/m^3$ (ppb)	1 hour	900 (344)	-	450 (172)	900 (344)	-
	24 hour	300 (115)	-	150 (57)	300 (115)	800 (306)
	Annual	60 (23)	-	30 (11)	60 (23)	-
Total Suspended Particulate Matter (TSP) $\mu g/m^3$	24 hour	120	-	-	120	400
	Annual	70	-	60	70	-
PM2.5 $\mu g/m^3$	24 hour, 98th percentile over 3 consecutive years	-	30 (by 2010)	-	-	-
PM10-2.5 $\mu g/m^3$		-	(to be recom-mended)	-	-	-
Carbon Monoxide mg/m^3 (ppm)	1 hour	35 (31)	-	15 (13)	35 (31)	-
	8 hour	15 (13)	-	6 (5)	15 (13)	20 (17)
Oxidants – ozone $\mu g/m^3$ (ppb)	1	160 (82)	-	100 (51)	160 (82)	300 (153)
	8 hour, based on 4th highest annual value, averaged over 3 consecutive years	-	130 {by 2010} (66)	-	-	-
	24 hour	-	-	30 (15)	50 (25)	-
	Annual	-	-	-	30 (15)	-
Hydrogen sulphide $\mu g/m^3$ (ppb)	1 hour	42 (30)	-	-	-	-
	24 hour	8 (6)	-	-	-	-

The table of regulations and guidelines is presented for completeness, however, the focus of this assessment is on particulate matter and greenhouse gas emissions.

Particulate emissions from surface coal mining can vary greatly. Many of the activities associated with surface coal mining lend themselves to air quality management through application of strict site controls, loading procedures, and active dust suppression. It is possible for surface mining operations to cause adverse effects (*i.e.*, dust) on near by properties; but it is also possible for surface mines operated with attention to control measures to exist without disturbing or adversely impacting the receptors nearby.

The potential for environmental effects related to offsite dust impacts are generally limited to within 500 m from source. Projects with neighbours within 500 m should therefore be operated with a higher attention level to environmental controls. The controls applied to reduce the potential for air quality impacts are often effective at reducing noise and other issues. For example, strict control on vehicle speeds on and near the mine site will reduce noise, particulate emissions, and be generally more acceptable to the area.

Mitigation

It is recommended that the following mitigation measures be used to control potential cumulative effects from airborne particles and vehicle emissions:

- Maintain equipment and trucks in good working order and inspect regularly.
- Develop and enforce a no-idling policy.
- Vehicle travel on unpaved surface is to be minimized, and gravel will be used on significant on-site roads.
- Pavement should extend from 100 m inside the mine site to the public roads.
- Truck tires should be washed prior to leaving the mine site to minimize the tracking of mud or loose material onto the public highways.
- Speed limits onsite should be strictly enforced, and visible plumes should not be permitted.
- Truck loads should be covered with well fitting tarpaulins or material with equivalent control.
- Water and calcium chloride or other approved dust suppressants should be applied during conditions leading to visibly dry roads or visible dust emission from vehicles on site.
- Drop heights from conveyors or excavators or other equipment should be minimized, and trunks shall be used where possible to avoid wind entrainment of fine particles during loading.
- The extent active working area should be minimized.
- Stockpiled material should be stabilized against wind and water erosion as soon as possible.
- Windbreaks can be used to reduce wind erosion from storage piles. Where possible, piles should be located downwind of existing tree lines, or landforms that afford erosion protection.
- A weather station, including anemometer, rain gauge, and wind direction indicator, should be installed on site and data should be recorded at a minimum on a 4 hour basis. At a threshold windspeed of 15 km/hr, site activity is to be reduced to a minimum level as provided in the operating permit.

- A system of monitoring shall be instituted that consists of the following elements
    - Dustfall samplers to be located at up to 5 residences within 500 m of the mine site, samples taken and determined monthly.
    - Total suspended particulate measurements to be made at agreed locations (typically nearest residence) for a five day period, twice a year. For each sample exceeding the provincial guideline during a period when the wind was oriented from the mine toward the sampler, the operator will submit a written explanation of the event and subsequent corrective action to NSEL.
    - On demand monitoring of up to 10 samples per month using swab samples at residences where it is alleged that soiling has occurred.
    - Random checking of trucks to the mine to verify that excess materials are cleaned from the vehicle prior to departure on public highways, and that the cargo cover is intact and secured.
- A community liaison committee should be established. The members of the community who elect to participate shall be provided with copies of all monitoring results and episode reports.

In addition to fugitive dust emissions, methane is naturally released to the atmosphere during mining activities (*i.e.*, production, processing, storage, and transportation). Environment Canada's Greenhouse Gas Inventory has established an emission factor for coal mining at 0.13 t methane per thousand tonnes of coal produced (0.13 t/kt). Alone, a relatively small operation may not result in the release of a significant amount of methane into the atmosphere; however, within CBRM, many coal mining projects operating at the same time have the potential, depending on the size of the various operation, to release more than a hundred tonnes of methane per year. Combined with other greenhouse gas (GHG) emission sources in the region, including existing and unreclaimed mining operations, this could result in an important cumulative contribution to GHG.

Residual Cumulative Effects

Provided that the measures listed above are diligently applied, the impact of the mining activities can be greatly reduced so that air quality standards are attained, and chronic problems are avoided. Workforce training and supervisory inspection and enforcement are key to ensuring that air quality standards are maintained. Provided these precautions are observed and maintained, cumulative impacts of particulate on air quality from surface mining are not likely to be significant.

Assuming that some or all of the projects proposed will occur, there will be a cumulative effect from the release of methane. Nova Scotia does not regulate methane or GHG emissions. As such, it is difficult to establish significance criteria. There are however initiatives to reduce GHG emissions nationally and globally.

5.4.1.2 Noise

Existing Environment

The existing noise environment is likely to be typical of the rural nature of the area. Daytime levels are likely to be of the order of 45 to 50 dBA, affected mainly by traffic and natural sounds. Nighttime levels are likely to fall into the 30-40 dBA range. Provincial regulations do not exist for noise, however planning guidance levels used by the NSEL and other provincial agencies are:

Daytime	7:00 AM – 7:00 PM	65 dBA
Evening	7:00 PM – 11:00 PM	60 dBA
Nighttime	11:00 PM – 7:00 AM	55 dBA

Several quarries in the Province operate 24 hours per day and show through monitoring, as required by their operating permits, that it is possible to achieve these levels consistently at property boundaries. In the case of the potential surface mining areas, the background levels are likely so low that meeting these levels by a small margin would still represent a significant increase in noise levels.

The type of heavy diesel engine equipment that will be used has noise levels that are of the order of 85 dBA at 15 m, attenuating to approximately 55 dBA at a distance of about 500 m. Because of the logarithmic nature of the noise scale, doubling the noise results in an increase of 3 dBA. The number of pieces of heavy equipment, plus ancillary sources of noise such as stackers, conveyors and the like is not known at this time for nearby receptors, but it is clear that it is possible for the noise levels to become problematic for nearby receptors unless mitigation is employed.

Mitigation

It is recommended that:

- The daytime, evening, and nighttime limits (65, 60, and 55 dBA) be strictly enforced at the perimeter of the mine site, but that the limits of 60, 55, and 50 dBA be enforced at the locations of the nearest residences, even if that requires a reduction in the perimeter limits.
- Strict speed controls be enforced on the approach and roads within the mine site.
- Equipment be maintained in best possible condition, particularly mufflers.
- All overburden piles be considered as advantageous opportunities to build temporary noise berms between operating machinery and affected residences.
- Permanent noise generating equipment must be located within noise absorbing shelters, or be placed in the "noise shadow" of excavation into the surface.

- The use of compression braking by trucks on site, and on the approaches be strictly forbidden, and subject to fines applied through contracts between the mine and transportation company.
- Backup alarms be minimized by creating and enforcing one-way traffic circulation through the site, eliminating the need for reversing vehicles.
- Noise monitoring is to be conducted semiannually for 72 hours at the 2 nearest residences, and the results are to be submitted to NSEL and any community liaison committee.
- Noise complaints are to be logged and addressed individually, and the log is to be submitted with the monitoring results to NSEL and the community liaison committee.
- Where practical, all plant activities should be scheduled to minimize disruption to the acoustic environment during the evening and nighttime hours.

5.4.1.3 Residual Cumulative Effects

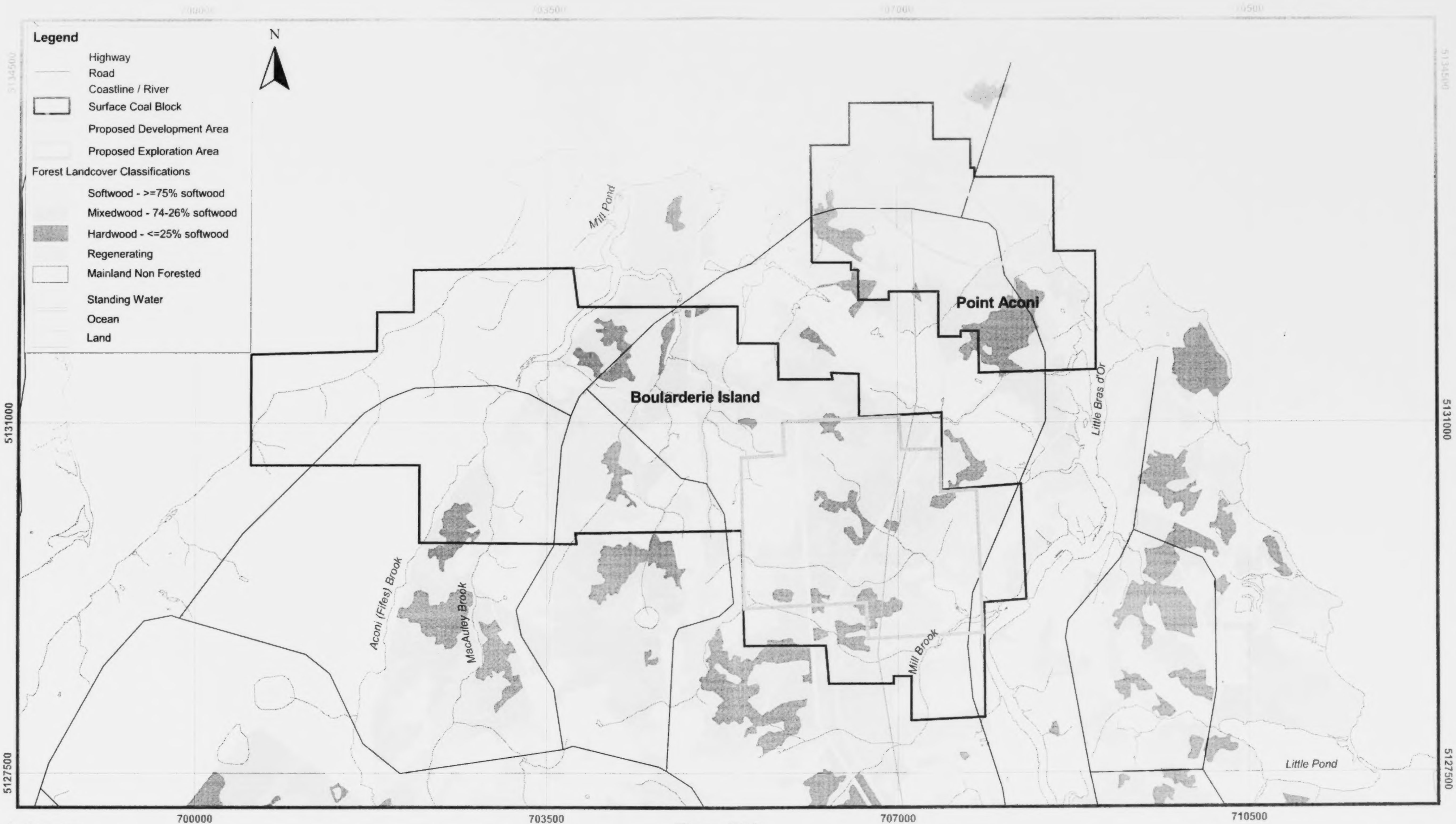
In general, cumulative impacts from surface coal mining on the acoustic environment are not expected to be an issue except perhaps with regard to truck traffic from other industrial activity or localized construction projects or industrial activity. However, given the rural nature of much of the receiving environment, and normally low levels of ambient noise, significant adverse effects may occur considering the relative change in noise levels, even through overall noise may be within provincial guideline levels. A more precise determination of significance of cumulative noise effects can only be determined through a project specific EA. Provided that the mitigation measure above are diligently applied, the cumulative impacts of the mine operations on the acoustic environment should not be significant.

5.4.2 Terrestrial Environment

Terrestrial environment is a VEC encompassing potentially valuable terrestrial habitats and ecosystems such as wetlands and forests that sustain a wide range of plant and animal species. Of particular concern for potential development are sensitive or unique habitats as well as the occurrence of rare or uncommon species. Many components of the terrestrial environment are protected by law.

5.4.2.1 Overview of Existing Conditions

Existing environmental conditions have been developed from resource mapping including forest classification (Figures 5.3A and 5.3B) land use classification (Figures 5.4A and 5.4B), and significant habitat (Figures 5.5A and 5.5B).


Legend
Highway
Road
Coastline / River
Surface Coal Block
Proposed Development Area
Proposed Exploration Area
Forest Landcover Classifications
Softwood - >=75% softwood
Mixedwood - 74-26% softwood
Hardwood - <=25% softwood
Regenerating
Mainland Non Forested
Standing Water
Ocean
Land
N
Mill Pond
Point Aconi
Boularderie Island
Little Bras d'Or
Aconi (Files) Brook
MacAuley Brook
Mill Brook
Little Pond
700000
703500
707000
710500
5134500
5131000
5127500
1 0 1 2 3 4
Kilometers

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS DNR Forest Inventory Mapping,
1988 - 2000, scale 1:50 000

Figure 5.3A

Point Aconi and Boularderie Island Surface Coal Resource Blocks Forest Classification

NOVA SCOTIA
Environment and Labour

Jacques Whitford

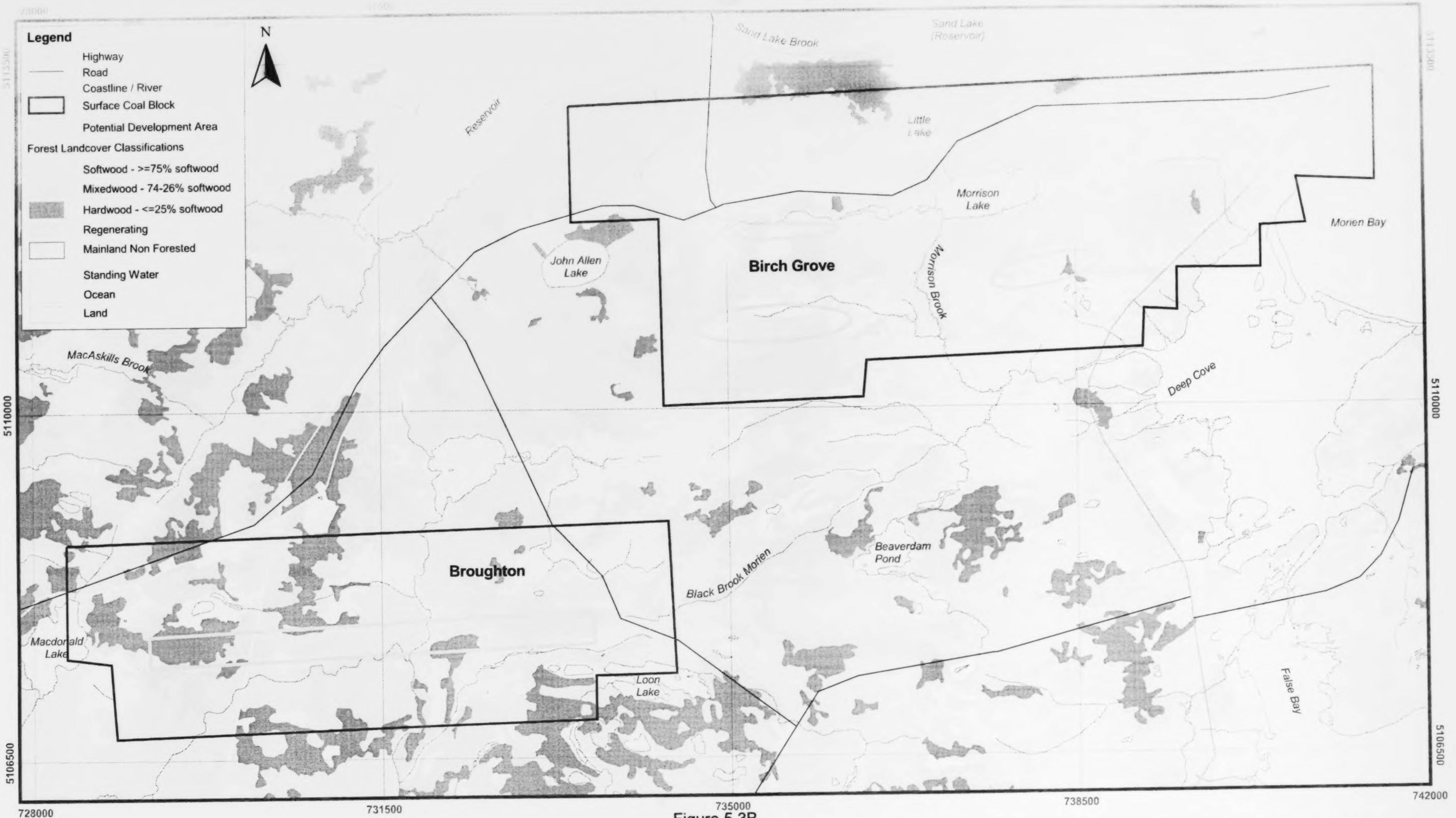

Legend
Highway
Road
Coastline / River
Surface Coal Block
Potential Development Area
Forest Landcover Classifications
Softwood - >=75% softwood
Mixedwood - 74-26% softwood
Hardwood - <=25% softwood
Regenerating
Mainland Non Forested
Standing Water
Ocean
Land
N
Sand Lake Brook
Sand Lake (Reservoir)
Reservoir
Little Lake
Morrison Lake
Morien Bay
John Allen Lake
Birch Grove
Morrison Brook
MacAskills Brook
Deep Cove
Broughton
Beaverdam Pond
Black Brook Morien
Macdonald Lake
Loon Lake
False Bay
5110000
5106500
728000
731500
735000
738500
742000

Figure 5.3B

Birch Grove and Broughton Surface Coal Resource Blocks
Forest Classification

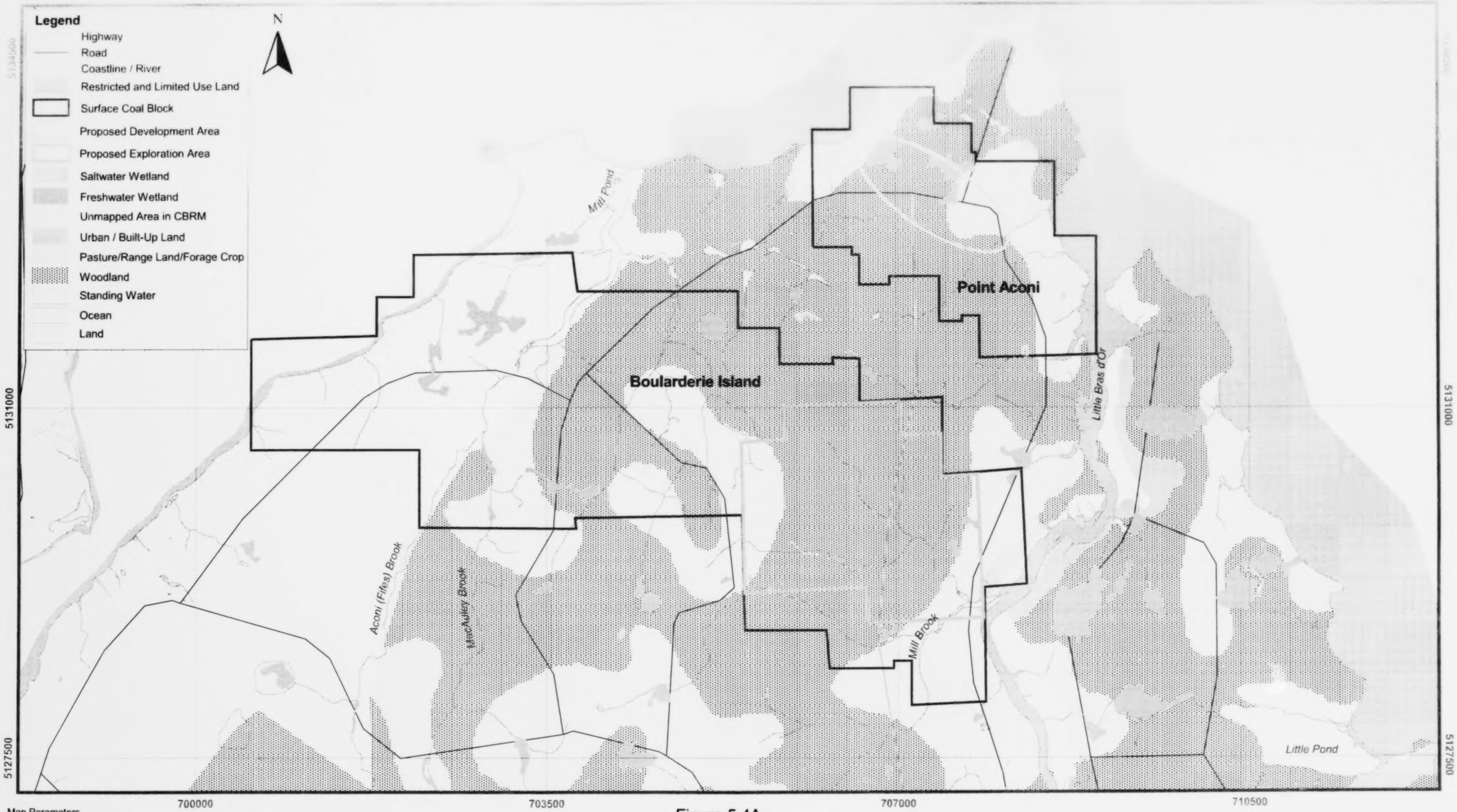
1 0 1 2 3 4
Kilometers

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS DNR Forest Inventory Mapping,
1988 - 2000, scale 1:50 000

NOVA SCOTIA
Environment and Labour

Jacques Whitford


Legend
Highway
Road
Coastline / River
Restricted and Limited Use Land
Surface Coal Block
Proposed Development Area
Proposed Exploration Area
Saltwater Wetland
Freshwater Wetland
Unmapped Area in CBRM
Urban / Built-Up Land
Pasture/Range Land/Forage Crop
Woodland
Standing Water
Ocean
Land
N
Mill Pond
Point Aconi
Boularderie Island
Little Bras d'Or
Aconi (Fifes) Brook
MacAulley Brook
Mill Brook
Little Pond
5134500
5131000
5127500
700000
703500
707000
710500

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
Canada Land Inventory, 1950 - 1970, scale 1: 250 000
NS DNR Wetland Inventory Mapping, scale 1:50 000
NS DNR Restricted and Limited Use Land Database, scale 1:50 000

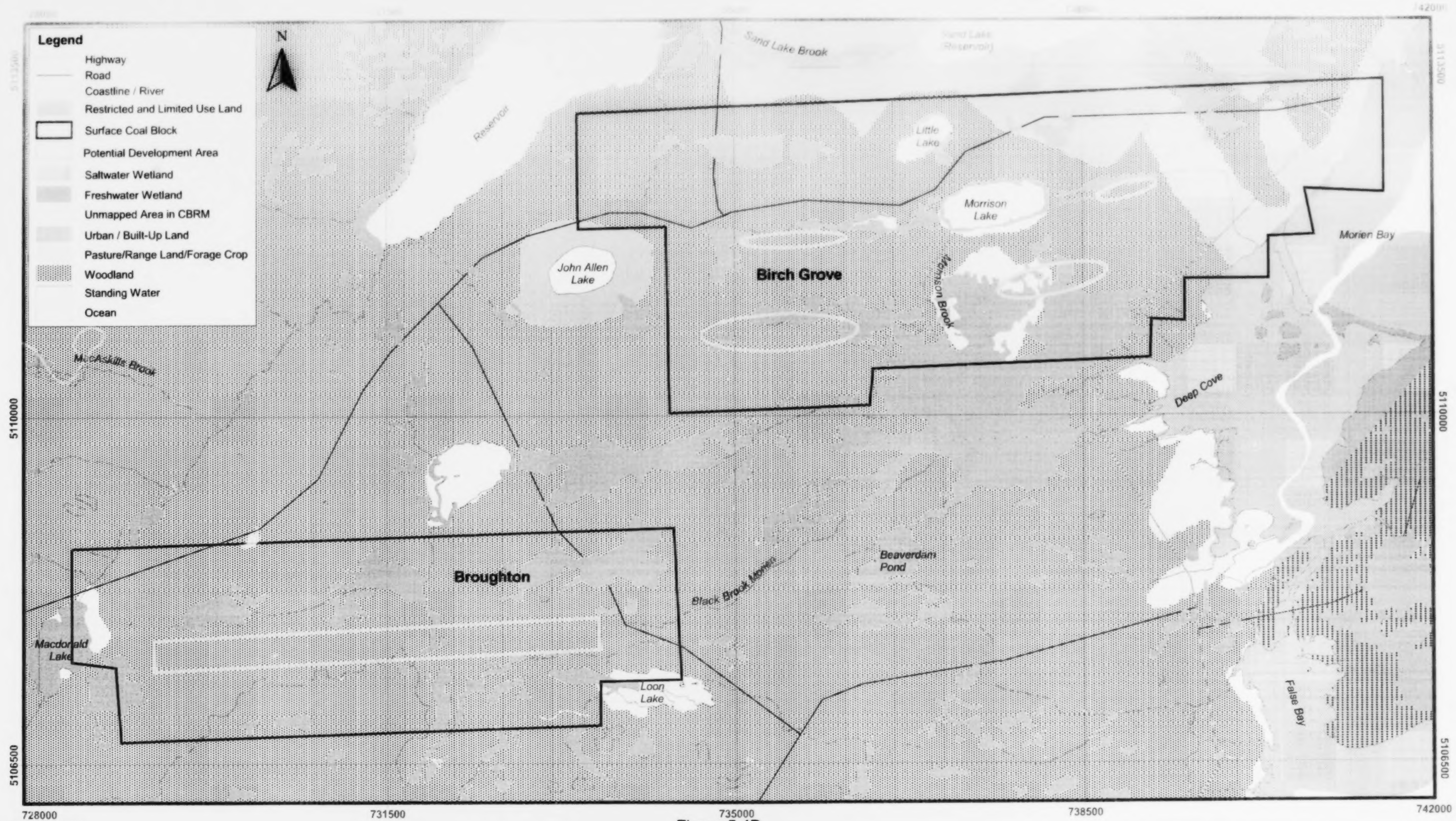
Figure 5.4A

Point Aconi and Boularderie Island Surface Coal Resource Blocks Land Classification

1 0 1 2 3 4
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford


Legend
Highway
Road
Coastline / River
Restricted and Limited Use Land
Surface Coal Block
Potential Development Area
Saltwater Wetland
Freshwater Wetland
Unmapped Area in CBRM
Urban / Built-Up Land
Pasture/Range Land/Forage Crop
Woodland
Standing Water
Ocean
N
Sand Lake Brook
Sand Lake Reservoir
Reservoir
Little Lake
Morrison Lake
John Allen Lake
Birch Grove
Morrison Brook
Morien Bay
MacAskills Brook
Deep Cove
Broughton
Black Brook Mouth
Beaverdam Pond
Macdonald Lake
Loon Lake
False Bay
5110000
5106500
5113500
728000
731500
735000
738500
742000

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
Canada Land Inventory, 1950 - 1970, scale 1: 250 000
NS DNR Wetland Inventory Mapping, scale 1:50 000
NS DNR Restricted and Limited Use Land Database, scale 1:50 000

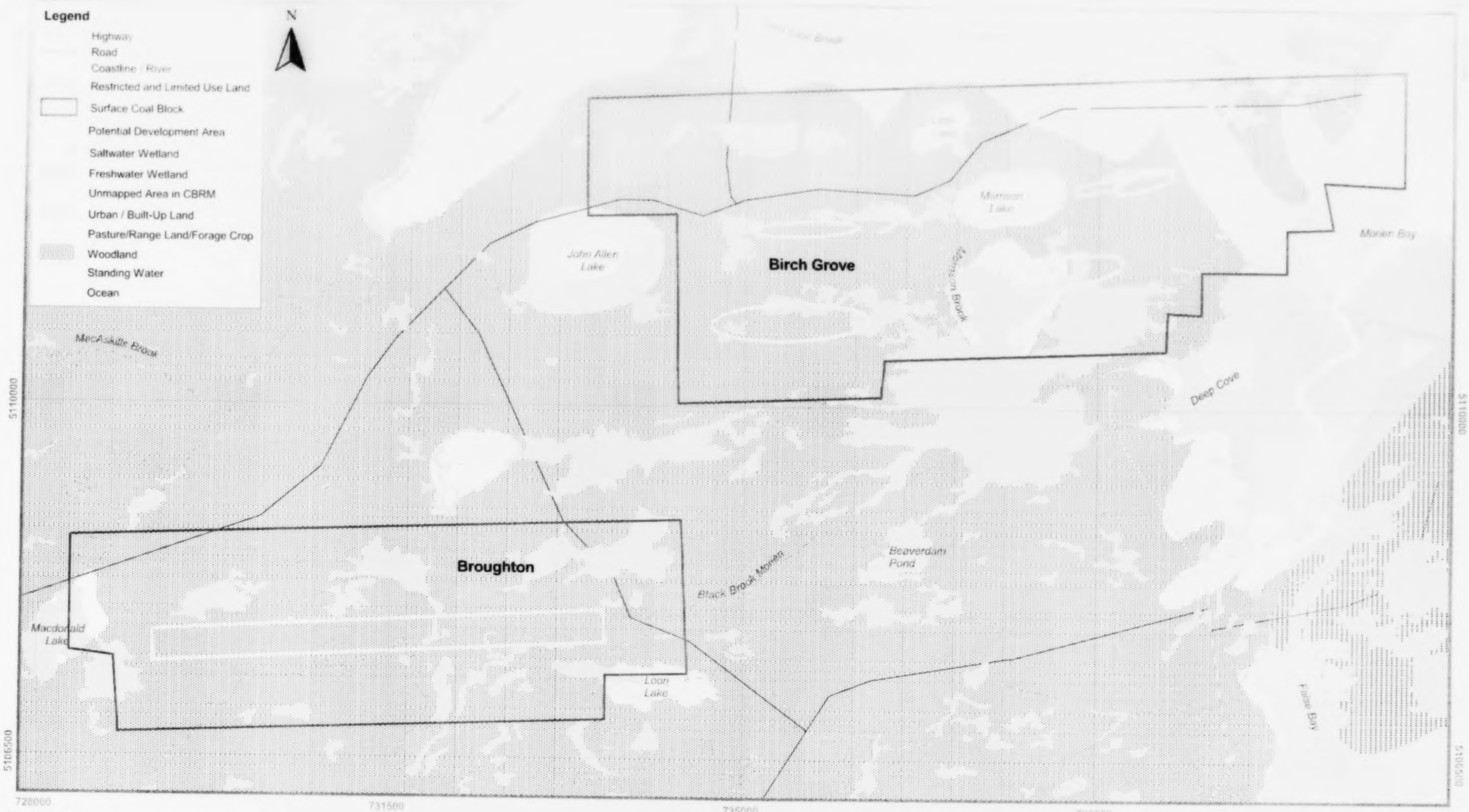
Figure 5.4B

Birch Grove and Broughton Surface Coal Resource Blocks Land Classification

1 0 1 2 3 4
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford


Legend
Highway
Road
Coastline / River
Restricted and Limited Use Land
Surface Coal Block
Potential Development Area
Saltwater Wetland
Freshwater Wetland
Unmapped Area in CBRM
Urban / Built-Up Land
Pasture/Range Land/Forage Crop
Woodland
Standing Water
Ocean
N
Birch Grove
Broughton
John Allen Lake
Morrison Lake
Morrison Brook
Morien Bay
Deep Cove
MacAskills Brook
Black Brook Morien
Beaverdam Pond
Macdonald Lake
Loon Lake
False Bay
5110000
5106500
728000
731500
735000
738500
742000

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
Canada Land Inventory, 1950 - 1970, scale 1: 250 000
NS DNR Wetland Inventory Mapping, scale 1:50 000
NS DNR Restricted and Limited Use Land Database, scale 1:50 000

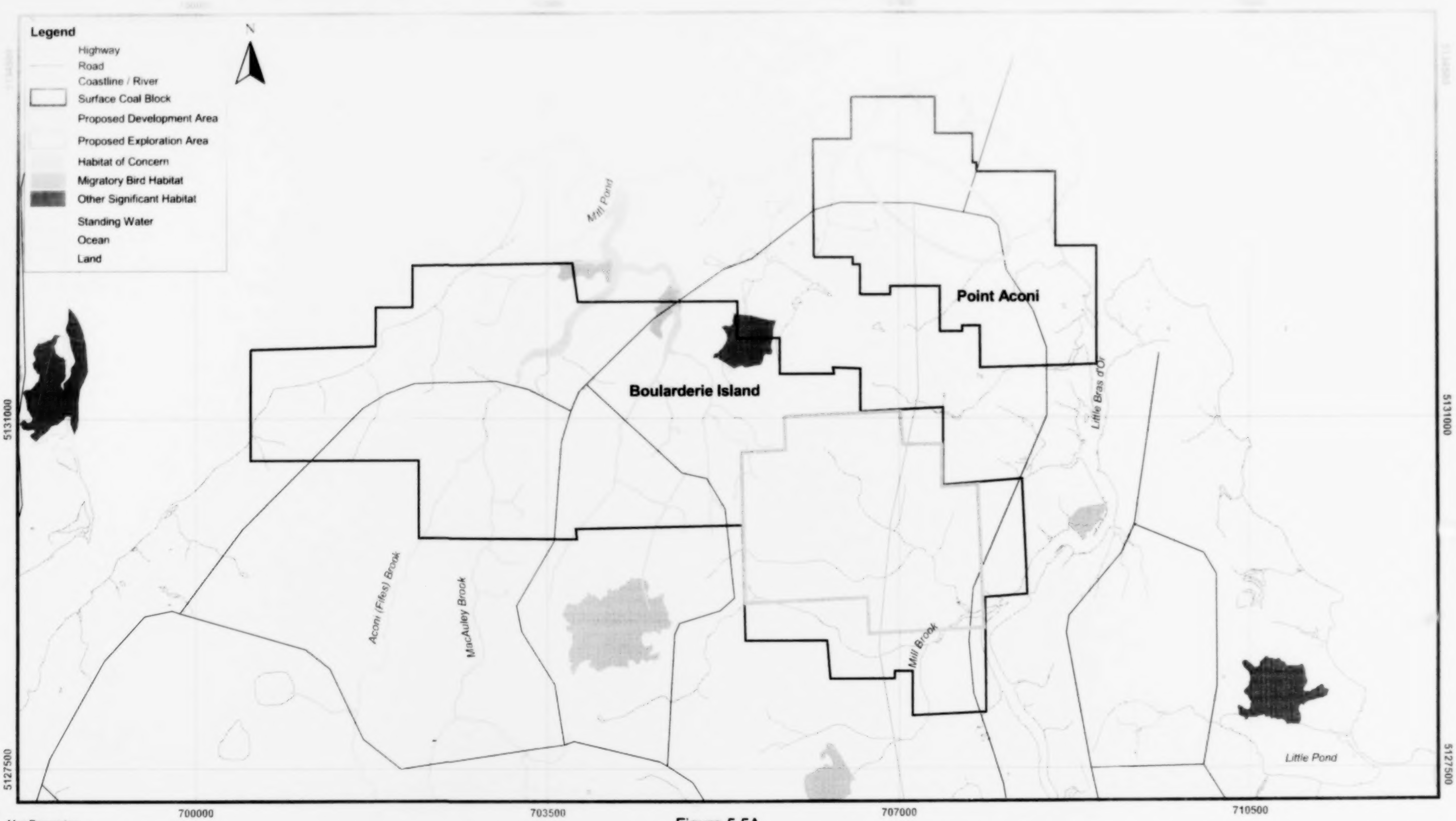
Figure 5.4B

Birch Grove and Broughton Surface Coal Resource Blocks Land Classification

1 0 1 2 3 4
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford


Legend
Highway
Road
Coastline / River
Surface Coal Block
Proposed Development Area
Proposed Exploration Area
Habitat of Concern
Migratory Bird Habitat
Other Significant Habitat
Standing Water
Ocean
Land
N
Mill Pond
Point Aconi
Boularderie Island
Little Bras d'Or
Aconi (Fifes) Brook
MacAuley Brook
Mill Brook
Little Pond
5131000
5127500
700000
703500
707000
710500

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS DNR Significant Species and Habitats Database,
Compiled by Samara Eaton, Oct. 2004

Figure 5.5A

Point Aconi and Boularderie Island Surface Coal Resource Blocks
Significant Habitats

1 0 1 2 3 4
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford

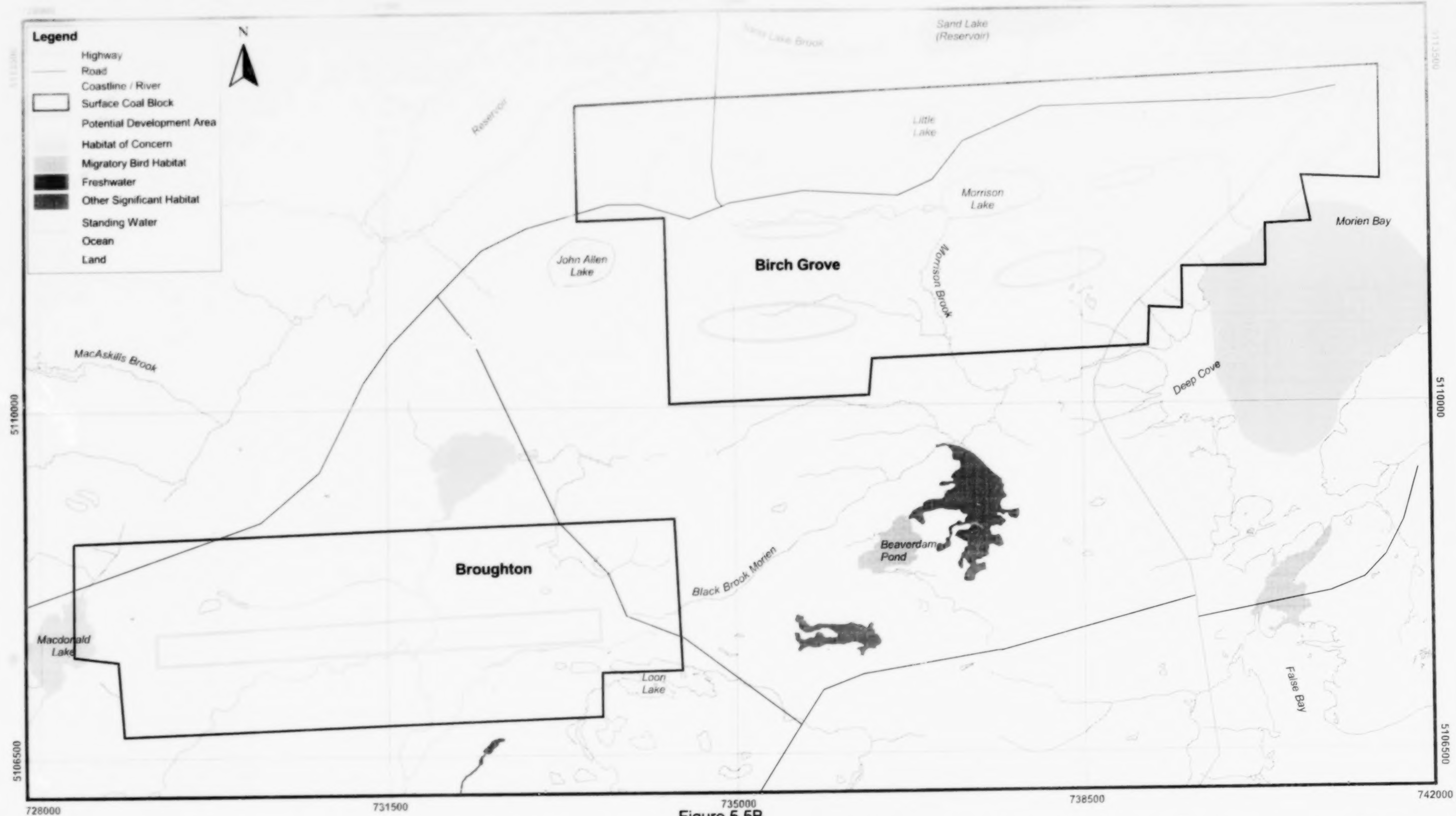

Legend
Highway
Road
Coastline / River
Surface Coal Block
Potential Development Area
Habitat of Concern
Migratory Bird Habitat
Freshwater
Other Significant Habitat
Standing Water
Ocean
Land
N
Sand Lake (Reservoir)
Reservoir
Little Lake
Morrison Lake
Morien Bay
John Allen Lake
Birch Grove
Morrison Brook
MacAskills Brook
Deep Cove
Beavordam Pond
Broughton
Black Brook Morien
Macdonald Lake
Loon Lake
False Bay
5110000
5106500
728000
731500
735000
738500
742000

Figure 5.5B

Birch Grove and Broughton Surface Coal Resource Blocks Significant Habitats

1 0 1 2 3 4

Kilometers

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:35,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS DNR Significant Species and Habitats Database,
Compiled by Samara Eaton, Oct. 2004

NOVA SCOTIA
Environment and Labour

Jacques Whitford

Point Aconi Block

Overall, the Point Aconi claim block is more heavily disturbed than the other three claim blocks. Sources of disturbance include past coal mining, residential development, a small amount of agriculture and road construction. Coal mining activity within the block includes subsurface mining and mining infrastructure, surface mining to the north and south of the site that impinges upon the claim block and hundreds of bootleg coal mines that are concentrated most heavily in the western portion of the claim block. Twenty shafts are recorded in the claim block (Figure 1.3A). Air photography of the claim block indicates that approximately 15% of the block is occupied by areas disturbed by mining or mining related infrastructure. This is a low estimate since hundreds of bootleg mines in the claim block are not visible on the available air photography.

Residential areas are restricted to the eastern quarter of the claim block along the highway to Point Aconi. Air photography of the area suggests that some small scale agriculture may occur in the south eastern corner of the claim block.

Forest cover occupies approximately 65% of the claim block. Softwood and mixedwood forest predominate, although hardwood forest is present in the southeast and southwest corners of the claim block (Figure 5.3A). Regenerating forests are present mainly along the eastern edge of the claim block. Most of the regenerating forest appears to be old fields that have been colonized by white spruce. A review of the NSDNR significant habitats data base did not reveal the presence of old forest in the claim block.

Wetland habitat is not as widespread and abundant in this claim block as in the Birch Grove and Broughton claim blocks (Figure 5.4A). Freshwater wetlands including bog and fen habitats are present in the northern third of the claim block while salt marsh, estuarine flat and marine flat habitats are present along the eastern edge of the claim block.

Topographic mapping indicates that sea cliffs are present on the eastern and western edges of the claim block. The NSDNR significant habitats database did not reveal the presence of any rare or endangered species or particularly valuable habitat within the claim block (Figure 5.5A). Nevertheless, some habitats present in the claim block have elevated potential to provide habitat for rare or endangered species of plants and animals. These include the bog and fen wetland habitat in the northern end of the claim block, the salt marsh and estuarine flats found in the east of the block on Little Bras D'Or, the sea cliffs found along the western and eastern edges of the claim block and riparian habitats found at various locations.

Boularderie Island Block

The Boularderie Island claim block is characterized by a relatively high proportion of anthropogenic habitats. Approximately 20% of the claim block has been modified by human activities including farming, past coal mining, linear developments (electrical transmission lines and roads) and residential development. Commercial agriculture accounts for most of the anthropogenic habitat. Past mining activity was largely restricted to the eastern end of the claim block in the vicinity of Mill Creek where six mine shafts have been recorded (Figure 1.3A). There may also be additional shafts and past mine workings on private lands but NSDNR does not evaluate these lands. Residential areas are found along all of the roads that pass through the claim block but residences are most concentrated along the eastern edge of the claim block near Mill Creek.

Forest cover is widespread in the claim block and consists of a fairly even mix of softwood, mixedwood and hardwood forest. Fairly extensive areas of regenerating forest are present in the claim block. These are most frequently associated with the margins of agricultural lands and around old mine sites. These areas appear to be a mixture of woodlots and areas of abandoned pasture and disturbed areas that have been colonized by early successional forest. No old forest stands have been identified within the claim block on the NSDNR significant habitats database.

Wetland habitat is not abundant in this claim block; however, a variety of wetland types are present including bogs, fens, deep marsh, shrub swamp and estuarine flat (Figure 5.4A). Several areas of important wildlife habitat are found in the western part of the claim block including Wood Duck nest boxes along Aconi Brook and a Bald Eagle nest east of Mill Pond.

Topographic mapping indicates that sea cliffs are present on the western edges of the claim block. The NSDNR significant habitats data base did not reveal the presence of any records of rare or endangered species in the claim block although species of conservation concern have been identified along Fifes Brook (Figure 5.5A). There are a number of habitats present in the claim block that have elevated potential to provide habitat for rare or endangered species of plants and animals. These include the various wetland habitats, riparian areas, sea cliffs, and marine shore lines.

Birch Grove

The Birch Grove claim area is a mixture of forest, wetland and anthropogenic habitats (Figure 5.3B). Most of the area is forested, with coniferous and mixedwood stands predominating. There are few hardwood stands in the area. Many of the forest stands in the area have been recently harvested and approximately 20% of the forest habitat in the claim block is classed as regenerating forest. None of the stands present in the claim block have been identified as old forest by NSDNR.

Wetland habitat is abundant and distributed throughout the claim block although the southern portion of the claim block has the highest concentration of wetland habitat (Figure 5.4B). This area is part of a large bog complex that extends outside of the claim block. The vast majority of wetland located within the claim block is classed as bog. A few areas of fen are present, typically in association with lakes and ponds, particularly Morrison Lake and the outlet of Little Lake.

A small area of dune habitat (Phalens Bar) is present at the eastern end of the claim block where it borders Morien Bay. Sea cliffs are present in the northeastern corner of the claim block on Morien Bay.

A number of anthropogenically modified terrestrial habitats are present in the claim block. These include residential areas that are concentrated mainly in the village of Birch Grove but also along the shore of Morien Bay. Some agricultural land, consisting mainly of hay fields is present, mainly around Birch Grove, Morien Junction, and along Morien Bay. Twenty-five coal mine shafts are found in the vicinity of Birch Grove (Figure 1.3B) as well as approximately 5 ha of area used to dispose of coal fines.

The NSDNR significant habitat data base does not identify any rare or endangered plant or animal species in the claim block (Figure 5.5B). However, there are habitats present within the claim block that have potential to harbour rare species, particularly rare vascular plants. Areas in the claim block with elevated potential for rare plants include the various wetland habitats, riparian habitats, the dune system at Phalens Bar and sea cliffs along the shore of Morien Bay. The shallow bay west of Phalens Bar has been identified by NSDNR as an area supporting species of conservation concern. This area consists of a mixture of mud flat, saltmarsh, beach and dune complex. It is considered to be one of the most significant areas for shorebird staging in Cape Breton. It is also used by a wide variety of waterfowl species as well. The area is used extensively by Bald Eagles and other raptor species. One of the small islands in the bay hosts a mixed nesting colony of Common and Arctic Terns. Both of these species are considered to be sensitive to human activities by NSDNR. This area has been identified as a candidate for designation as an Important Bird Area due to the high numbers of shorebirds present.

Broughton

The Broughton claim block is a sparsely settled, heavily forested area (Figure 5.3B). Most of the area is covered in softwood stands which are typically associated with imperfectly drained areas with low relief. Hardwood stands are associated with areas of high relief such as hill tops and relatively steep slopes. Mixedwood stands are also present and tend to be found on gentle slopes or along stream courses. No old forest stands have been identified in the Broughton claim block by NSDNR.

Wetland habitat is scattered throughout the Broughton claim block (Figure 5.4B). Most wetlands in the area are bogs. However, there are also fens present and a shrub swamp and deep marsh are present along the southern boundary of the claim block.

Anthropogenic habitats are present in the northwestern and southeastern corners of the claim block. Residential areas are present along the Morrison Road in the northwest and adjacent to Loon Lake in the southeast.

Areas affected by past coal mining activities are present along a band that extends from MacDonald Lake to just north of Loon Lake that straddles the Tracey and MacDonald Lake seams. A total of 15 mine shafts are present along this band (Figure 1.3B). These include a large deposit of coal waste and areas grubbed as part of a recent bulk sampling program.

The NSDNR significant habitat database does not identify any rare or endangered plant or animal species, habitats of concern or protected areas in the claim block (Figure 5.5B). Wetlands and riparian areas are the habitats most likely to support rare or endangered species of plants or animals within this claim block.

5.4.2.2 Effects Assessments and Mitigation

General Effects

Surface coal mining can adversely affect the terrestrial environment in a number of ways including: habitat loss; habitat fragmentation; adverse effects on wetland habitat; acid drainage; sensory disturbance to wildlife; and introduction of non-native species.

Mitigation

Mitigative measures that can be used to reduce the effect of habitat loss include:

- Clear only the amount of habitat required.
- Wherever possible, place new areas of disturbance on areas that have been previously disturbed.
- Clear outside of the breeding season for migratory bird species.
- Avoid sensitive habitats such as wetlands and riparian habitats wherever possible.
- Utilize progressive reclamation to speed up the development of habitat suitable for native plants and animals.
- Establish appropriately sized buffers around populations of rare or particularly sensitive species of plants and animals and monitor these populations to ensure that mitigation is successful.

Habitat Edge and Habitat Fragmentation

The creation of habitat edge around the mine workings and access roads creates habitat attractive to many animal species, however, the edge habitat is also attractive to a variety of generalist predators such as crows, raccoons, coyotes, foxes and feral dogs and cats which may place heavy predation pressure on animals attracted to these areas. These areas can become reproductive sinks which attract large numbers of animals but which produce relatively few offspring due to high predation rates. Habitat edges also attract Brown-headed Cowbirds which parasitize the nests of a wide variety of passerines. Nest parasitism can substantially reduce the nesting success of birds whose nests are parasitized and which have not evolved behavioral adaptations to counter nest parasitism.

The creation of deforested areas as a result of surface coal mining will result in habitat fragmentation. Habitat fragmentation can adversely affect plant and animal species in several ways. Discontinuities between habitat patches can prevent the immigration or emigration of organisms between patches. Small populations trapped in small patches are more prone to local extirpation since immigration into recently vacated habitat patches may not be feasible. These small populations may also be prone to long term degradation of fitness as a result of inbreeding. Animals often require a variety of habitats and habitat fragmentation can result in the creation of barriers between essential habitat types such as foraging and breeding habitats. Loss of a migration corridor between essential habitat types can lead to local extirpation. For some species, habitat fragmentation can greatly reduce the suitability of the remaining habitat. Some species are forest interior specialists that cannot survive in close proximity to edge habitat. These species are often sensitive to generalist predators that patrol the edges of habitats or are out competed by species that thrive in edge habitat. As the size of habitat fragments decreases the proportion of suitable interior habitat within the habitat fragments decreases substantially and eventually when the fragment reaches a critical size, no suitable interior habitat remains. The effects of habitat fragmentation vary substantially between species. Some species thrive in edge habitat and benefit from habitat fragmentation. Forest interior species are much more sensitive to habitat fragmentation. Species with different abilities in regards to mobility or proclivity to cross open habitats can vary substantially in their sensitivity to habitat fragmentation. Highly mobile bird populations are unlikely to become trapped in habitat fragments while some small mammals, amphibians and reptiles with less effective dispersal capabilities and a reluctance to leave heavy cover can easily become trapped. Mammals, amphibians and reptiles that migrate between separate but essential habitat types can be particularly susceptible to habitat fragmentation.

Mitigation

The following mitigative measures could be used to help reduce the effects of habitat fragmentation and the creation of habitat edge on plant and animal populations:

- Shape the footprint of the project to reduce the amount of habitat edge. A round project footprint reduces the length of edge habitat produced and helps to reduce the potential for adverse effects associated with habitat fragmentation. Long narrow footprints or highly indented footprints greatly increase the amount of edge habitat and the degree of habitat fragmentation.

- Where habitats may become isolated as a result of project related disturbance, provide corridors of undisturbed habitat to connect fragments with large blocks of contiguous habitat to allow movement of animals and plants between habitat patches. Riparian habitats provide good wildlife corridors. Corridors must be wide enough to allow animals to feel secure so that they will make use of the corridor.
- Make the project footprint as compact as possible. Avoid sprawl of facilities.
- Use progressive reclamation to minimize the size of the project footprint and to speed up the development of habitats that do not represent a barrier to the movement of wildlife.

Adverse Effects on Wetlands

Surface coal mining can result in adverse effects to wetlands located adjacent to the mine site. Dewatering of the mine can draw down the water table in the area adjacent to the mine resulting in the alterations of wetland hydrology which can adversely affect the ability of the wetland to provide suitable habitat for plants and animals. Alternatively, water pumped from mine workings can enter wetlands or watercourses that feed wetlands resulting in flooding of these wetlands which can be equally disruptive. Alterations in the geomorphology of the mined area can affect the dispersal of water in the watershed which can also adversely affect wetland hydrology. The construction of access roads can adversely affect wetlands if culverts are improperly installed resulting in ponding or drainage of the wetland.

Mitigation

Mitigative measures that can be used to reduce the effects of surface coal mining on wetlands include:

- Avoid disturbing wetlands wherever possible.
- Provide adequate buffers around wetlands to prevent dewatering of wetlands associated with draw down of groundwater levels around the pit.
- Do not discharge mine water into natural wetlands except in instances where development of the pit has altered the water balance of the wetland. Polished mine water may need to be diverted into the wetland to make up for water that has been intercepted by the pit.
- In instances where roads cross the inflows or outflows of wetlands, ensure that culverts are adequately sized and positioned to prevent ponding or draining of the wetland.
- Provide compensation for wetland habitat lost due to project activities.

Acid Drainage

Exposure and oxidization of pyritic minerals during mining can result in the generation of acid drainage which can adversely affect plants and animals present in wetlands as a result of high acidity, mobilization of metals and smothering of plants and animals with iron floc.

Mitigation

Use mitigation and best management practices to detect, monitor and control acid drainage (See Section 4.0).

Introduction of Non-native Species

Importation of construction equipment from other areas can increase the potential for non-native plant species to be introduced into the area. The use of non-native species for reclamation can also increase the potential for the establishment of non-native species that may establish in and disrupt native plant communities. Roads constructed to the mine site can provide corridors along which noxious non-native species such as purple loosestrife can migrate into new areas.

Mitigation

Earth moving equipment brought to the mine site from other areas should be washed and inspected to ensure that seeds and rhizomes of non-native plant species are not introduced onto the mine site. Wherever possible native species should be used for reclamation. Grubbings from areas being mined can be used as a source of seeds and rhizomes of native species if they are not stockpiled for excessive periods. If native species are not available, non-native species that have been present in the Province for many decades and which have not demonstrated a propensity to compete effectively with native species may be used to provide ground cover.

Area Specific Effects of Surface Coal Mining in the Four Claim Blocks

It is not possible to accurately assess the adverse and beneficial cumulative effects of surface coal mining in the four claim blocks with existing information. The locations, sizes, and configurations of the proposed mine workings are not available although areas where mining would be feasible have been identified. This has important implications regarding the types of habitats and species potentially affected and the degree to which the project could affect them. A smaller project footprint would be less destructive than a larger one. A project located on previously disturbed habitat would have less of an adverse effect than one located on undisturbed habitat. A mine site with a round footprint and few associated roads would create less edge habitat and habitat fragmentation than a mine site of similar area with an irregularly shaped footprint with many associated roads.

The general level of the assessment as well as the lack of site specific field survey data also limit the cumulative effects assessment. The presence of rare or sensitive species and the presence of unusual or sensitive habitat types is best revealed through directed field surveys that are focused on the footprint of the project and the areas immediately adjacent to it rather than through a review of existing data over very large areas.

It is possible to make some general statements regarding the effects of surface coal mining in and around the four claim blocks given the existing data and the likelihood that mining activity will occur in the areas of the claim blocks where mining is believed to be most feasible. These general assessments are presented in the following text.

Birch Grove Block

Four areas have been identified as having potential for surface coal mining at Birch Grove. The two sites having the highest potential are located on the Spencer seam while two sites having lower potential are situated on the Gowrie seam. The western Spencer seam site is located in what appears to be an undisturbed area. Much of the area is occupied by bog which is part of a very large bog complex that extends outside of the claim block. No rare or endangered species have been identified in this area; however, bogs have relatively high potential to provide habitat for rare plants and wetlands in general are considered to be valuable and sensitive habitats. Development in this area will result in the loss of bog habitat and dewatering of the pit would have adverse effects on the hydrology of the bog habitat surrounding the pit. Bogs require thousands of years to develop, consequently, it would be difficult to replace all of the functions of this wetland should wetland replacement be recommended as compensation.

The eastern Spencer seam site is also located within the same large bog that the western Spencer seam site is located on. As such, the effects of mining at this site are expected to be similar to those predicted for the western site. This site is located approximately one kilometer from the proposed candidate Important Bird Area at Phalen Bar. This distance should be sufficient to attenuate noise associated with mining activity to a level where it is unlikely that it would disturb the shorebirds and waterfowl that use this area.

The eastern Spencer seam site is partially located in an area adversely affected by past mining activities. Coal waste is present and acidic drainage is associated with the old mine site. Surface coal mining could either add, as a cumulative effect, to the existing adverse effects associated with the old mine site or could eliminate these effects depending on where the pit is located. If the footprint of the new mine overlaps that of the old mine, the coal waste responsible for the acidic drainage problem will be removed, eliminating this problem. Similarly, other adverse effects such as habitat loss or degradation associated with the old mine site would be eliminated and replaced by the effects of the new mine if the two sites occupy the same footprint. If the old and new mines were to occupy different footprints adjacent to each other the adverse effects of both mines would be retained creating a cumulative adverse effect. Forest inventory mapping for this area indicates that much of the forest in the vicinity of the proposed surface coal mine is in an early stage of succession probably as a result of forest harvesting. This would contribute to a cumulative adverse effect.

The western secondary mine sites located on the Gowrie seam is partly located within bog habitat and follows the course of a stream that feeds into Morrison Lake. Both of these habitats have elevated potential to support rare plant species. The hydrology of several bogs and a fen located along the stream would probably be affected by dewatering of the pit as well as by inputs of sediment from the mine site and possible adverse effects associated with acidic drainage.

The eastern secondary mining site on the Gowrie seam is partially located within a bog that serves as the headwaters for a stream that flows into the proposed candidate Important Bird Area at Phalen Bar. The bog has elevated potential to provide habitat for rare plant species as does the stream that drains it. The bog would probably be largely destroyed by mining activity and residual portions of it would be affected by dewatering of the pit. There is potential for sediment and acidic drainage to enter the stream that drains the bog. Contaminants that might enter the stream could end up in the candidate Important Bird Area.

Broughton Block

The area in which mining would be expected to occur in the Broughton claim block is a long strip located between the Tracey and MacDonald Lake seams which extends from the old mine site near Loon Lake to approximately 500m east of MacDonald Lake. No rare or endangered species or sensitive habitats have been identified in this area and the strip avoids most of the wetland habitat present in the claim block. Several small wetlands fall within the strip including three fens and a bog. The strip also passes through two streams that converge and drain to the south. The wetland and riparian habitats potentially provide habitat for rare plants. Surface mining of the entire strip would result in the destruction of the wetlands and would necessitate the relocation of the two streams. The long thin shape of the footprint of the area of expected mining would create a substantial amount of habitat edge and would contribute more to habitat fragmentation than a more rounded footprint.

Sources of cumulative effects in this claim block include past mining sites, as well as forestry activities. Past mining has occurred largely within the area where surface mining is expected to occur. Adverse effects currently associated with these old mine sites would be replaced by adverse effects associated with the surface mine since the old mine structures and mine waste would be consumed by the surface mine. As such, there would be limited potential for cumulative effects associated with old mine sites.

Point Aconi Block

In the Point Aconi claim block mining is expected to occur in the northwestern portion of the block. No rare or endangered species or species of conservation concern have been identified in this area. However, the expected area of mining includes most of the freshwater wetland habitat present in the claim block including two bogs and a fen. These are also the largest wetlands within the claim block. The southeastern end of the area likely to be mined also includes part of a stream. The wetland habitats and riparian habitats have elevated potential to provide habitat for rare plant species. One advantage of this site is that much of it has already been disturbed by past mining activity. Much of the southern end of the expected mining area falls within the footprint of the Prince Mine. The northern end of the expected mining area contains numerous bootleg mines. Establishment of a surface coal mine here would reduce the amount of undisturbed habitat affected by the project.

Surface mining of this area would contribute substantially to habitat fragmentation in the area. The Point Aconi claim block is bounded to the north and south by large areas that have been disturbed by mining activity. Large scale surface mining activity in the Point Aconi claim block would bisect the habitat patch that currently separates the two existing strips of disturbed habitat creating two relatively narrow strips of habitat. This may adversely affect forest interior species in the claim block. The effect of habitat fragmentation in this area of the claim block is offset somewhat by the fact that much of the habitat that would be lost to surface coal mining is already heavily disturbed.

Past and future activities in the area that could contribute to adverse cumulative effects include possible forest harvesting operations and past mining activities. In areas where the footprints of these activities are outside of the footprint of the surface mine; adverse cumulative effects would occur. If the footprints coincide with that of the surface mine, the adverse effects of these other activities (i.e., cumulative effects) would be nullified and replaced by the adverse effects associated with the surface mine.

Boularderie Island Block

The area where mining would be expected to occur in the Boularderie Island claim block includes the eastern third of the claim block. This location avoids all of the environmental constraints identified on the NSDNR Significant Habitats mapping. It also avoids most of the wetlands in the claim block and all of the larger wetlands. However, four small wetlands will be affected including two bogs, a deep marsh and a shrub swamp. These habitats have elevated potential to provide habitat for rare plant species. The mine would also result in the loss of riparian habitat along a small stream course that drains into Mill Creek which may also provide habitat for rare plant species.

The shape of the area expected to be mined is roughly square in shape which will reduce the amount of edge habitat produced and the degree of habitat fragmentation.

5.4.2.3 Residual Effects Summary

Surface coal development will adversely affect the terrestrial environment through loss of habitat and habitat fragmentation. Some of this habitat may be unique or sensitive and harbour rare or uncommon species. These effects will be cumulative to the extent that they interact with habitat effects from other projects, including other coal mining projects. Standard mitigation and BMPs, including avoidance of sensitive habitats or compensation for lost habitat (*e.g.*, wetlands) and proper reclamation can be effective in reducing these impacts to non-significant levels. However, in the absence of project-specific assessment, it is not possible to provide a definitive determination of significance and significant cumulative adverse effect on the terrestrial environment.

Locating a surface mine development in the footprint of a previously disturbed area can help to minimize adverse cumulative effects and possibly improve them through proper site reclamation, including habitat restoration.

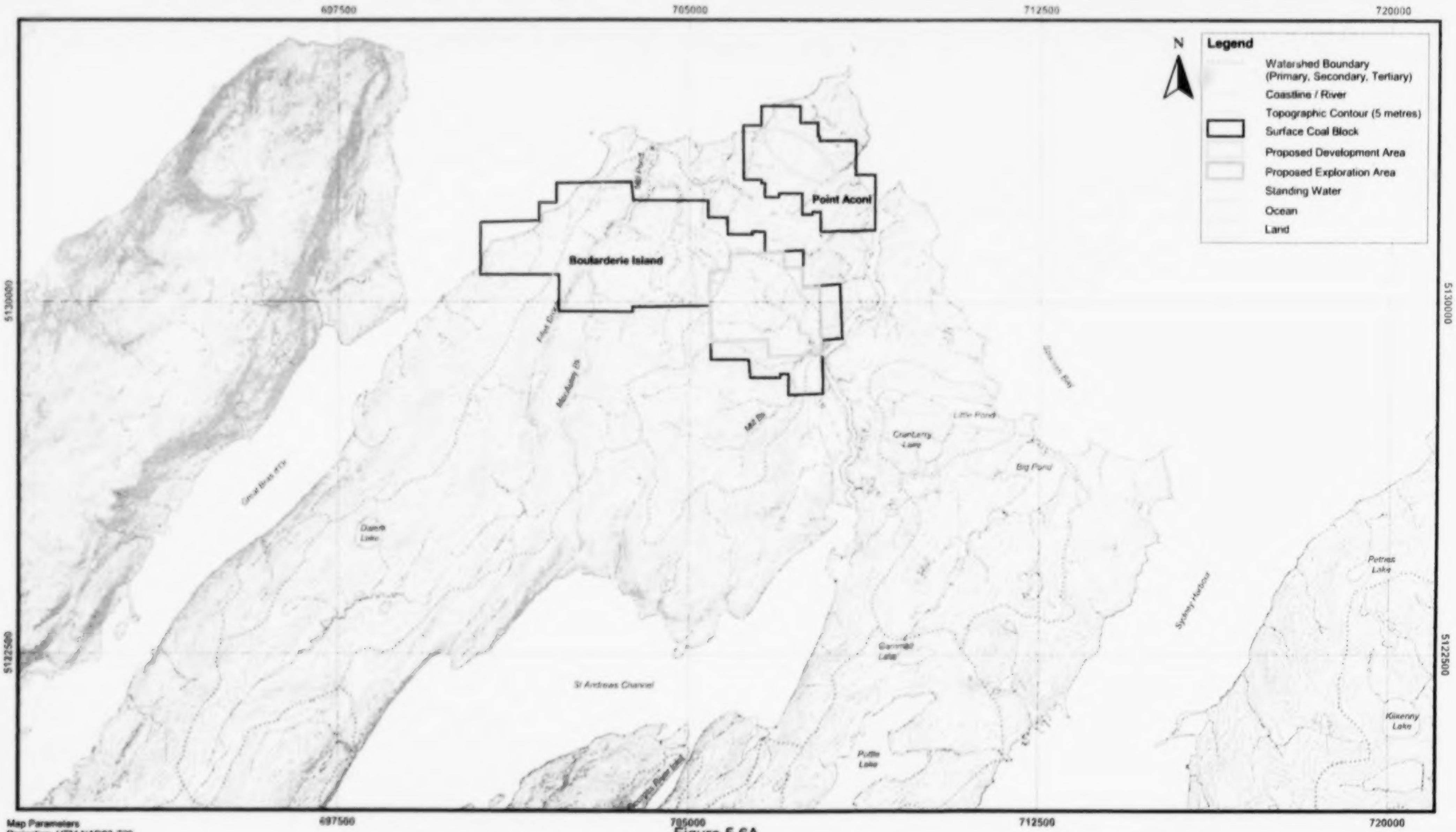
5.4.3 Fish and Fish Habitat

The magnitude and extent of surface mining impacts on aquatic life depends on the mining technology employed, extent of the disturbance, chemical and physical composition of the mineral and its overburden, surface and subsurface hydrologic patterns, and reclamation activities. The direct impacts on fish habitat (*i.e.*, water quality and substrate) and subsequently the indirect impacts on fish from coal mining are well documented in the literature. Due to the severity of potential impacts on fish and fish habitat in this region from coal mining operations, these ecosystem components are included as VECs.

5.4.3.1 Overview of Existing Environment

Point Aconi Block

Based on 1:50,000 scale topographic mapping, the Point Aconi block encompasses coastal marine environments, five catchment areas for four unnamed watercourses, and one small pond within the block. The unnamed watercourse, on the western boundary of the block area contains a large ponded featured, Morrison Pond. These watercourses are first order streams, and all draining directly to seawater. There are likely many more watercourses in the block that are not indicated on the mapping. The presence of several bogs and a fen suggest that these wetlands drain via unidentified watercourses. Wetlands are acidic environments and receiving watercourses may be affected by lower pH contributions. Surface water features and watersheds for the block are presented on Figure 5.6A.


697500
705000
712500
720000
5130000
5122500
N
Legend
Watershed Boundary (Primary, Secondary, Tertiary)
Coastline / River
Topographic Contour (5 metres)
Surface Coal Block
Proposed Development Area
Proposed Exploration Area
Standing Water
Ocean
Land
Point Aconi
Boularderie Island
Great Bras d'Or
St Andrews Channel
Sydney Harbour
Spanish Bay
Cranberry Lake
Little Pond
Big Pond
Petries Lake
Kilkenny Lake
Gammell Lake
Puddle Lake
Mill Bk
MacAdam Bk

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:75,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS Watershed Areas Map Series, compiled and drawn
by MRMS, 1980, scale 1:50 000

NSTS, 1987, scale 1:10 000

Figure 5.6A

Point Aconi and Boularderie Island Surface Coal Resource Blocks
Surface Water Resources

1 0 1 2 3
Kilometers

NOVA SCOTIA
Environment and Labour

Jacques Whitford

There are no data on fish habitat or fish species readily available for the watercourses in the Point Aconi block (T. Power NSDNR pers. comm. 2005). DFO did not provide watercourse specific information. Because each of the watercourses flows into the sea, there is the opportunity for migration of anadromous and catadromous fish species. This opportunity is largely dictated by slope and gradient of the watercourse, stream morphology and water flow. Brook trout, *Salvelinus fontinalis*, are ubiquitous to Nova Scotia watercourses and are a likely resident species occupying these watercourses.

Streams in this region are typified with a pH range between 6.4 and 7.1 (NSM 1997). The area geology provides adequate buffering capacity against the acid precipitation that plagues the Province. The pH levels are well suited to support salmonid species.

Boularderie Island Block

The Boularderie Island block overlays the large drainage basins of Mill Pond and Mill Brook. Both of these basins are very large with multiple subwatersheds. The Mill Pond basin is very extensive (Figure 5.6A).

The NSDNR significant species and habitats database show the McAuley and Aconi Brooks to be designated as significant habotat. Aconi Brook (aka Fifes Brook) supports brook trout and Atlantic salmon. The adjacent MacAuley Brook stream supports gaspereau, smelt, brook trout and Atlantic salmon (T. Power, NSDNR, pers. comm., 2005). Atlantic salmon, striped bass and Atlantic whitefish are classified by NSDNR as species at risk. Brook trout, gaspereau and four-spine stickleback are considered sensitive to human activities and natural events.

The presence of this diverse fish fauna is indicative of supporting habitat. The condition of the habitat throughout the brooks is unknown. There appears to be no records of fish species on the Mill Brook watersheds; however, the basin drains into Little Bras d'Or which is seawater, thus the potential for anadromous and catadromous species to occur is highly likely. DFO commented that the brooks, ponds and creeks near Boularderie Island are inhabited by salmon in the fall and trout in the summer (B. Brown, DFO, pers. comm., 2005).

Streams in this region are typified with a pH range between 6.4 and 7.1 (NSM 1997). The area geology provides adequate buffering capacity against acid precipitation. The pH levels are well suited to support salmonid species.

Birch Grove Block

The Birch Grove lease overlays four drainage basins and encroaches upon a fifth basin. The drainage basins of Black Brook Morien and a small unmade coastal tributary drain into Deep Cove. The other two drainage basins are to the north and drain into two reservoirs (Figure 5.6B). The fifth basin that the western lease boundary encroaches upon drains to the Mira River, but there are no watercourses identified in 1:50,000 mapping in that vicinity; however, smaller watercourses may be present.

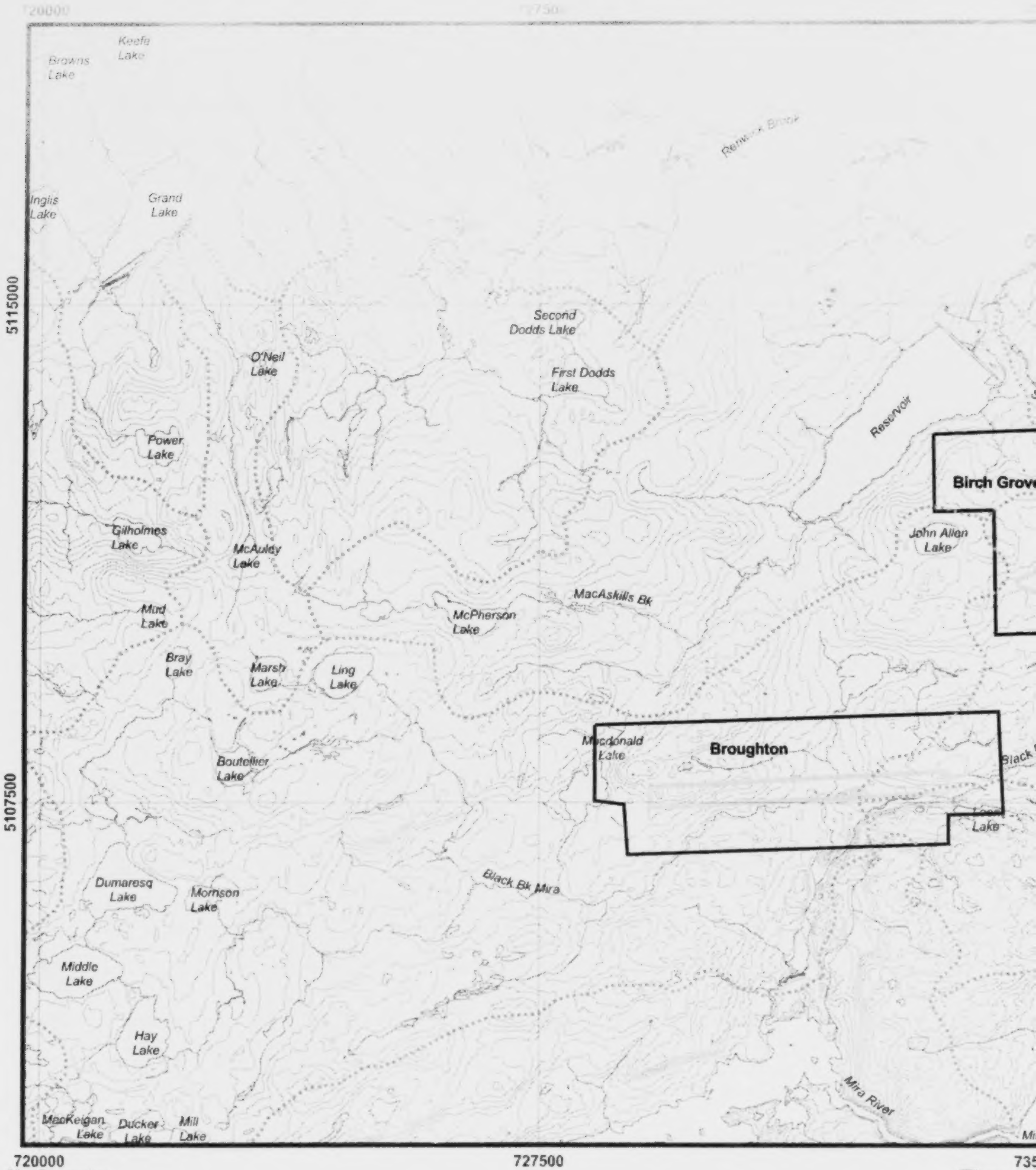
NSDNR has no data on fish species in these watercourses (T. Power, NSDNR, pers. comm, 2005) and DFO stated that the streams in the Birch Grove lease area are inhabited by trout in the summer (B. Brown, DFO, pers. comm 2005). As a minimum, brook trout are a likely resident species, and watercourse which drain to the sea have the potential to support anadromous and catadromous fish species. Salmon are found in Morrison Brook in the fall (B. Brown, DFO, pers. Comm. 2005).

Broughton Block

The Broughton block overlays four drainage basins. The majority of the block lies within the Mira River drainage basin. The eastern portion of the block lays in the drainage basin of the Black Brook Morien as well as the drainage basin for Loon Lake which flows into the sea (Figure 5.6B). NSDNR has no data on fish species in these watercourses (T. Power, NSDNR, pers. comm, 2005) and DFO did not provide comment on fish fauna or habitat in these watercourses. However, the NSDNR significant species and habitats database show the Mira River tributary in the block to be designated as a significant habitat. Specific rationale for this designation is not provided in the database with exception of a broad classification scheme provided below:

- sites where species at risk or other species of conservation concern can be found and/or;
- sites where unusually large concentrations of wildlife occur and/or;
- habitats that are rare in the Province.

Therefore, it must be assumed from the lack of specific species information, that a species at risk or of conservation concern is present in that watershed area.


720000
727500
5115000
5107500
Keefe Lake
Browns Lake
Renwick Brook
Inglis Lake
Grand Lake
Second Dodds Lake
O'Neil Lake
First Dodds Lake
Reservoir
Power Lake
Birch Grove
John Allen Lake
Gilholmes Lake
McAuley Lake
MacAskills Bk
Mud Lake
McPherson Lake
Bray Lake
Marsh Lake
Ling Lake
Macdonald Lake
Broughton
Black
Boutellier Lake
Lake
Black Bk Mira
Dumaresq Lake
Morrison Lake
Middle Lake
Hay Lake
Mira River
MacKeigan Lake
Ducker Lake
Mill Lake
Mi
735

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:75,000
Project No.: NSD19669
Date: September 7, 2005

Data Source:
NS Watershed Areas Map Series, compiled and drawn by MRMS, 1980, scale 1:50 000

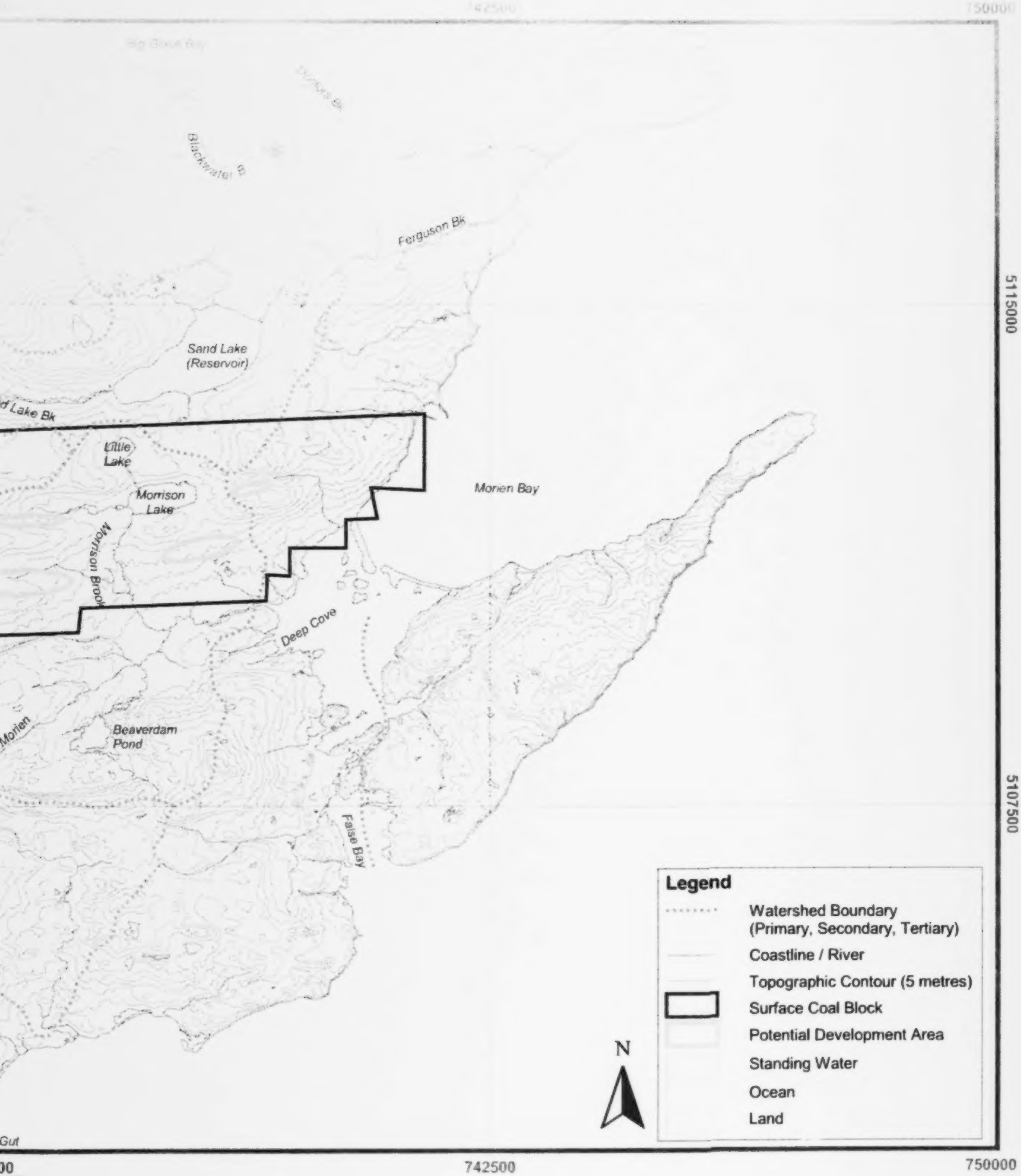
NSTS, 1997, scale 1:10 000

Figure 5

Birch Grove and Broughton Su
Surface Wate

1 0 1

Kilomet


742500
750000
Big Glace Bay
Blackwater B
Ferguson Bk
Sand Lake (Reservoir)
Lake Bk
Little Lake
Morrison Lake
Morrison Brook
Morien Bay
Deep Cove
Beaverdam Pond
Morien
False Bay
Gut
5115000
5107500
00
742500
750000
Legend
Watershed Boundary (Primary, Secondary, Tertiary)
Coastline / River
Topographic Contour (5 metres)
Surface Coal Block
Potential Development Area
Standing Water
Ocean
Land
N

6B

rface Coal Resource Blocks
Resources

2 3

s

NOVA SCOTIA
Environment and Labour

Jacques Whitford

5.4.3.2 Effects Assessment and Mitigation

All four of the surface coal mining block areas are extensive in size and overlay several drainage basins. Development activities within those watersheds that could interact cumulatively with proposed coal mining activities may include:

- dams (*e.g*, hydroelectric, reservoirs);
- forestry;
- urban/rural development; and
- mining.

Dams

There is twenty-five years of information on the effects of dams on fisheries and aquatic ecosystems. Fish are affected directly by physical barrier of migration routes and movement of fish; inundation of spawning grounds within the reservoirs; irregular release of dam and periodic inundation or drying out of spawning grounds and refuge area downstream of the dam. Fish are affected indirectly to different levels, depending on species, by modification of velocity, temperature and quality of water. The change in habitat caused by construction of a dam can modify the fish community population densities and areas utilised by a particular species. Fish moving downstream can be drawn through water intakes that also put their survival at risk.

Forestry

Forestry practices in Nova Scotia are largely by clear cutting with little active replanting. The landscape and hydrology is usually dramatically transformed with the mass removal of vegetation. Logged areas can result in unstable soils, higher water temperatures and increased sediment deposits in spawning gravel. Food for fish can decline and rearing habitat can disappear with the trees. The supply of large, woody debris that naturally formed the structure for fish habitat may also disappear.

It was not possible to determine the amount of active forestry in the watersheds occupied by the blocks; however, the forest classification mapping (Figures 5.3 A and B) shows areas of forest regeneration which can be assumed to represent logged areas. Some of these logged areas are adjacent to many of the watercourse and lakes in the block. The 1:10,000 airphotos of the Boularderie Island block show large patches of cleared land that are not agricultural fields.

Urban/Rural Development

Outside of the major communities, which tend to be established along the coast, the residential and commercial areas are relatively small in the lease areas. Urbanization involves changing the terrain, road construction and wastewater disposal. Erosion and sedimentation and road salting are the most common inputs into watercourses. Improperly installed culverts under roadways usually create barriers for fish migration. The discharge of sewage or failing septic systems contribute pollutants into the aquatic environment.

Farming practices relative to aquatic environment is not well regulated. Farmers tend to clear land to the waters edge, and those practitioners with grazing livestock permit their animals to wade through ponds and streams for watering access. Farm practices promote erosion, and contamination from manure (directly and indirectly) and runoff from farm chemicals (*e.g.*, fertilizers).

Land use within the Boularderie Island block is dominated by farming, with at least five large farms in the area. All these farms appear to border alongside watercourses of MacAuley Brook and Mill Brook.

There appears to be agricultural activity in the Birch Grove block. A sewage treatment facility is planned for a community in the Birch Grove area. The airphotos show a patchwork of non-descript cleared lands.

The Broughton block contains the least amount of land disturbance.

Mining

In addition to coal, Cape Breton contains mines for various types of resources. No data was readily available indicating other mining interests such as aggregate (sand and gravel pits) mining, marble/granite quarrying or heavy metal mining.

The Point Aconi block contains the now closed Prince Mine which operated between 1975 and 2001. Pioneer Coal Ld. proposes to reclaim this site as part of their surface coal mine development project (Pioneer Coal Ltd. 2005). During its operation, acid mine drainage was treated in a facility on-site. The Point Aconi block is peppered with abandoned and or active illegal pits which may be a source of acid drainage. The majority of the Point Aconi block has been subjected to significant terrain alteration and disturbance.

The Boularderie Island and Birch Cove blocks have no active legal coal mining. A coal washing operation operated within the Broughton block from 1893 to 1897. Both lease areas are peppered with illegal coal pits. The Boularderie Island block has only a few illegal pits, the least amount compared with the other blocks, however, all are located near watercourses.

Surface mining is highly visible land use because it temporarily eliminates surface vegetation and can permanently change topography as with mountain-top removal and valley fill operations. It also permanently and drastically alters soil and subsurface geologic structure and disrupts surface and subsurface hydrologic regimes. The surface subsidence following long-wall deep mining can dewater stream reaches and divert flows into different surface stream channels that are not adjusted to such increased flows.

Altered patterns and rhythms of delivery can be expected as well as changes in water quality.

The backfilled, reclaimed surface mine site creates a, porous "geological recharge area" where infiltrating water percolates through the fill to emerge as a seep or a spring. Often, these are very acidic and will flow even when drought conditions dry up natural waters. Additionally, many receiving streams have naturally little alkalinity (<10 mg/l), and great volumes or distances are required to neutralize even small mine flow that may carry 1,000 mg/l or 2,000 mg/l of acid. Many small streams, even though they are low in alkalinity, are valuable trout streams.

Even with current regulations, all types of surface mining can affect fish and aquatic resources through erosion and sedimentation, dewatering of wetlands, diverting and channelizing streams, and contaminating surface water and aquifers with toxic chemicals. These negative effects can occur with unregulated mining or when a company does not follow its mining plan. The result is a loss of sensitive species, biodiversity, and ecosystem integrity. Changes occur in the productivity of aquatic ecosystems through effects on reproduction, growth, behavior, and migration. The accumulation of contaminants in fish may render them unsuitable for human consumption. Chemical pollution can result in a complete and "permanent" loss extending far downstream. Although some impacts, such as increased erosion, are generally associated with mining, others are directly related to specific mining industries and geographic region. A brief review of some types of mining follows.

Sand and gravel resources are ubiquitous and are probably the most commonly mined resource. The most important sources of sand and gravel are river channels, floodplains, and previously glaciated terrain. Problems with aggregate mining include increase sediment bed load through re-suspension, physically eliminating fish habitat and benthic organisms, and destroying fish spawning and nursery areas, all of which ultimately change aquatic community composition. It may also alter river channel hydrology function and hydrologic function and stability.

Peat is typically mined after a wetland has been drained, but some operations use dredging. Currently, only one peat deposit is being mined in near Kennetcook, Nova Scotia, but peat mining is developing rapidly in Canada and could disrupt important fish and wildlife habitats.

Copper, silver, gold, lead, zinc, and other heavy metals are frequently mined and milled during the same mining operation. Open pit or underground mining accounts for most of their production. The ratio of these metals to associated materials is relatively low, resulting in large quantities of finely powdered mill wastes. Land restoration is difficult because milled wastes (tailings) cannot be returned to the mine and ultimately contribute to erosion problems at the site. Trace metals in the tailings create a water pollution problem through metal contamination.

Acid Mine Drainage

One of the most significant environmental concerns around coal mining and aquatic environments is acid mine drainage (AMD). The influx of untreated acid mine drainage into streams can severely degrade both habitat and water quality often producing an environment devoid of most aquatic life and unfit for desired uses. The severity and extent of damage depends upon a variety of factors including the frequency, volume, and chemistry of the drainage, and the size and buffering capacity of the receiving stream" (Kimmel 1983).

Pyrite (yellow and lustrous form of iron disulfide) which often occurs in coal and overlying strata, when exposed to air and water, oxidizes, producing iron and sulfuric acid. Ferric iron, when discharged to surface water, hydrolyzes to produce hydrated iron oxide and more acidity. The acid lowers the pH of the water, making it corrosive and unable to support many forms of aquatic life. Acid formation is most serious in areas of moderate rainfall where rapid oxidation and solution of exposed minerals can occur. Various impacts range in severity from isolated nuisance type problems to severe water quality impacts affecting large volumes of groundwater and miles of watercourse. Impacted uses include agricultural (irrigation and livestock), industrial, and potability of water supplies along with recreational uses, scenic resource appreciation, and aquatic organism habitat. The aggressive nature of mine drainage may also result in corrosion and encrustation problems with respect to such structures as pipes, well screens, dams, bridges, water intakes, and pumps. Acidic mine drainage in particular can also be toxic to vegetation when recharging to the shallow groundwater system and soil water zones.

Mine drainage is a complex of elements that interact to cause a variety of effects on aquatic life that are difficult to separate into individual components. Toxicity is dependent on discharge volume, pH, total acidity, and concentration of dissolved metals. pH is the most critical component, since the lower the pH, the more severe the potential effects of mine drainage on aquatic life. The overall effect of mine drainage is also dependent on the flow (dilution rate), pH, and alkalinity or buffering capacity of the receiving stream. The higher the concentration of bicarbonate and carbonate ions in the receiving stream, the higher the buffering capacity and the greater the protection of aquatic life from adverse effects of acid mine drainage (Kimmel 1983). Alkaline mine drainage with low concentrations of metals may have little discernible effect on receiving streams. Acid mine drainage with elevated metals concentrations discharging into headwater streams or lightly buffered streams can have a devastating effect on the aquatic life. Secondary effects such as increased carbon dioxide tensions, oxygen reduction by the oxidation of metals, increased osmotic pressure from high concentrations of mineral salts, and synergistic effects of metal ions also contribute to toxicity (Parsons 1957). In addition to chemical effects of mine drainage, physical effects such as increased turbidity from soil erosion, accumulation of coal fines, and smothering of the stream substrate from precipitated metal compounds may also occur (Parsons 1968; Warner 1971).

Benthic (bottom-dwelling) macroinvertebrates are often used as indicators of water quality because of their limited mobility, relatively long residence times, and varying degrees of sensitivity to pollutants. Unaffected streams generally have a variety of species with representatives of all insect orders, including a high diversity of insects classed in the taxonomic orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT taxa). Like many other potential pollutants, mine drainage can cause a reduction in the diversity and total numbers, or abundance, of macroinvertebrates and changes in community structure, such as a lower percentage of EPT taxa. Moderate pollution eliminates the more sensitive species (Weed and Rutschky 1971). Severely degraded conditions are characterized by dominance of certain taxonomic representatives of pollution-tolerant organisms, such as earthworms (Tubificidae), midge larvae (Chironomidae), alderfly larvae (Sialis), fishfly larvae (Nigronia), cranefly larvae (Tipula), caddisfly larvae (Ptilostomis), and non-benthic insects like predaceous diving beetles (Dytiscidae) and water boatmen (Corixidae) (Nichols and Bulow 1973; Roback and Richardson 1969; Parsons 1968). While these tolerant organisms may also be present in unpolluted streams, they dominate in impacted stream sections. Mayflies are generally sensitive to acid mine drainage; however, some stoneflies and caddisflies are tolerant of dilute acid mine drainage.

Fish are often used as indicators of pollution; however, they are not as useful as macroinvertebrates because of their greater mobility. Fish may temporarily swim through a non-lethal impacted area or away from a discharge of intermittent duration. Cooper and Wagner (1973) found that a pH of 4.5 and total acidity of 15 mg/L accounted for complete loss of fish in 90% of streams studied. Although no concentrations of metals were taken into account, Cooper and Wagner indicated that the absence of fish in acidified waters can be related to dissolved metals at certain pH levels. They also indicated that sulfates, a major constituent of acid mine drainage, did not become toxic to fish until concentrations exceeded the saturation level of several thousand mg/L.

The primary causes of fish death in acid waters is loss of sodium ions from the blood and loss of oxygen in the tissues (Brown and Sadler 1989). Acid water also increases the permeability of fish gills to water, adversely affecting gill function. Ionic imbalance in fish may begin at a pH of 5.5 or higher, depending on the tolerance of the species; severe anoxia will occur below pH 4.2 (Potts and McWilliams, 1989). Low pH that is not directly lethal may adversely affect fish growth rates and reproduction (Kimmel 1983).

Heavy metals can increase the toxicity of mine drainage and also act as metabolic poisons. Iron, aluminum, and manganese are the most common heavy metals which can compound the adverse effects of mine drainage.

Heavy metals are generally less toxic at circumneutral pH. Trace metals such as zinc, cadmium, and copper, which may also be present in mine drainage, are toxic at extremely low concentrations and may act synergistically to suppress algal growth and affect fish and benthos (Hoehn and Sizemore 1977). Some fish, such as brook trout, are tolerant of low pH, but addition of metals decreases that tolerance. In addition to dissolved metals, precipitated iron or aluminum hydroxide may form in streams receiving mine discharges with elevated metals concentrations. Ferric and aluminum hydroxides decrease oxygen availability as they form; the precipitate may coat gills and body surfaces, smother eggs, and cover the stream bottom, filling in crevices in rocks, and making the substrate unstable and unfit for habitation by benthic organisms (Hoehn and Sizemore 1977). Scouring of iron flocculant increases turbidity and suspended solids and may inhibit fish feeding.

Aluminum rarely occurs naturally in water at concentrations greater than a few tenths of a milligram per liter; however, higher concentrations can occur as a result of drainage from coal mines, acid precipitation, and breakdown of clays (Hem 1970). The chemistry of aluminum compounds in water is complex. Aluminum combines with organic and inorganic ions and can be present in several forms. Aluminum is least soluble at a pH between 5.7 and 6.2; above and below this range, aluminum tends to be in solution (Hem 1970; Brown and Sadler 1989). Most information on the effects of low pH and aluminum on aquatic life is based on studies of acid precipitation, such as those summarized in Haines (1981), Morris et al. (1989), and Mason (1990). Of the three major metals present in mine drainage, aluminum has the most severe adverse effects on stream aquatic life. The addition of aluminum ions compounds the effect of low pH by interacting with hydrogen ions, further decreasing sodium uptake, and increasing sodium loss in blood and tissues. High calcium concentrations generally reduce mortality and sublethal effects of low pH and elevated aluminum by reducing the rate of influx of hydrogen ions into the blood. Streams most susceptible to degradation from elevated aluminum, however, normally have low concentrations of calcium.

Stream investigations have indicated that a combination of pH less than 5.5 and dissolved aluminum concentration greater than 0.5 mg/L will generally eliminate all fish and many macroinvertebrates. Aluminum is most toxic to fish at pH between 5.2 and 5.4 (Baker and Schofield 1982). Streams with precipitated aluminum usually have lower numbers and diversity of invertebrates than streams with low pH and high dissolved aluminum. Precipitated aluminum coats the stream substrate, causing slippery surfaces and difficulty for insects to maintain position in the current. Aluminum precipitate can also be directly toxic to macroinvertebrates and fish. Rosemond *et al.* (1992) stated that deposition of aluminum hydroxide particles on invertebrates blocks surfaces important for respiratory or osmoregulatory exchange. Precipitated aluminum can also accumulate on fish gills and interfere with their breathing (Brown and Sadler 1989).

Iron is a common component of mine drainage which can have a detrimental effect on aquatic life. Like aluminum, iron can be present in several forms and combines with a variety of other ions. The impact of mine drainage containing elevated iron on aquatic ecosystems is complex. Little animal life may be found in streams with the lowest pH (under 3.5) and elevated dissolved iron concentrations. Alderflies, fishflies, dipterans, and aquatic earthworms will be present if the pH rises slightly. With further increases in pH, a more diverse assemblage of macroinvertebrates may be present, although total numbers may be lower than in nondegraded streams.

Manganese is another metal that is widely distributed in mine drainage. It can be present in a variety of forms and compounds and complexes with organic compounds. Manganese is difficult to remove from discharges because the pH must be raised to above 10.0 before manganese will precipitate. Manganese, therefore, is persistent and can be carried for long distances downstream of a source of mine drainage. Less information is available on the effects of elevated manganese concentrations on aquatic life than the effects of iron and aluminum. Perhaps this is because manganese in mine drainage is usually associated with other metals which may have a more deleterious effect or mask the effect of the manganese. Manganese discharge limits have traditionally been based on the objectionable discoloration effects of manganese at concentrations as low as 0.2 mg/L in water supplies rather than effects on aquatic life.

Mitigation

Any mining project will result in adverse environmental effects some of which may be cumulative with effects from other projects and activities affecting aquatic habitat. The significance of those effects is determined, in part, by specific site conditions, mining methods, and the corporate commitment and due diligence of the company towards environmental protection. To avoid and minimize impacts of mining on the aquatic environment, all watercourses, waterbodies and wetlands must be considered in the pre-planning phase, in particular during the environmental assessment and reclamation planning. The existing stresses, if any, from other activities in the watersheds must be considered, particularly during an assessment of cumulative effects.

During terrain disturbance and stockpiling, erosion and sedimentation must be controlled to a minimum standard as identified in the Nova Scotia Sediment and Erosion Control Handbook and in accordance with the Nova Scotia Pit and Quarry Guidelines.

Buffer zones are a protective measure for keeping equipment out of the watercourse, controlling water temperature, and nutrients, providing in-stream habitat, and invertebrate prey items for fish. However buffer zones do not control hydrology. A significant portion of water for most watercourses is provided by groundwater baseflow (discharge) and these upwellings in the gravel stream beds are potential spawning areas for trout. Excavation around a watercourses buffer zone could result in diversion of the groudwater flow that sustains a stream in dry weather. Therefore, a hydrological assessment must be undertaken to mitigate effects to watercourse hydrology.

Acid mine drainage must be controlled using the best available technology. Off-site impacts of mining on surface water resources can generally be controlled while the site is being mined, but many, acid-potent coal reserves cannot be mined with current technology without risk of "residual acid seepage."

Although there is Province-to-Province variation, Canadian regulations generally require mined lands to be returned to a productive state. (refer to Section 4.0).

In most areas, proper reclamation after surface coal mining reduces off-site impacts, mitigates aesthetic damage to disturbed land, and reconstructs topography, soil profiles, and hydrologic patterns to permit a wide range of options for future land use that will protect valuable aquatic resources. There is even an opportunity to enrich, cool, and stabilize stream flows. Proper selection, operation, and reclamation of mine sites are opportunities to effectively manage natural resources. Specifically, surface-mined areas, quarry sites, gravel pits, re-created wetlands, and reclaimed surface mine ponds and lakes present an opportunity for resource managers. Resource managers not only have an interest in seeing that suitable fisheries habitat is created, but that enhancement techniques are employed to optimize production and use of aquatic resources. Water quality can be improved by working with geologists and mining engineers. Turbidity can be reduced, and an enriched, cool, steady flow of usable water can sometimes be produced. Expert fish biologist input is required; this should be timely, useful, and effective input. The "Order Respecting the Removal or Displacement of Gravel in or about Certain Waters of the Province of British Columbia" was designed with direct input from fisheries managers to protect spawning grounds of Pacific salmon and other fish species. Fisheries biologists should have a valuable role in providing information leading to laws regulating the mining industry.

A complete description of mitigative measures and best management practices for potential application with regard to protection of fish and fish habitat is presented in Section 4.

5.4.3.3 Summary of Cumulative Effects

Adverse impacts to fish and fish habitat could occur as a result of any new coal mining activity. The watercourses in each block are current receiving environments from agricultural practices, urban development, sewage discharges, past mining, forestry and likely many other anthropogenic inputs. The Province of Nova Scotia is subject to acid precipitation which is a significant environmental stressor to fish and fish habitat. Standard mitigative measures and best management practices (*e.g*, avoidance of sensitive habitat, management of erosion and sedimentation and acid discharge) can potentially reduce impacts to fish and fish habitat to non-significant levels. However, significant adverse effects on fish and fish habitat remain possible and a definitive assessment of the significance of cumulative effects as well as assimilative capacity can only be made during a project specific assessment.

5.4.4 Water Resources

The four proposed resource blocks are located in rural unserviced areas of CBRM. Any residences in these areas would be serviced by on-site water supply wells and septic disposal systems. Depending on proximity of proposed surface mines, these water supply wells could theoretically be at risk from mine associated activities, notably lowering of the water table, and possible water quality changes.

There are also three surface public water supply watersheds in the vicinity of the Birch Grove claims area; these are MacAskills Brook Reservoir, John Allen Lake, Sand Lake and Schooner Pond.

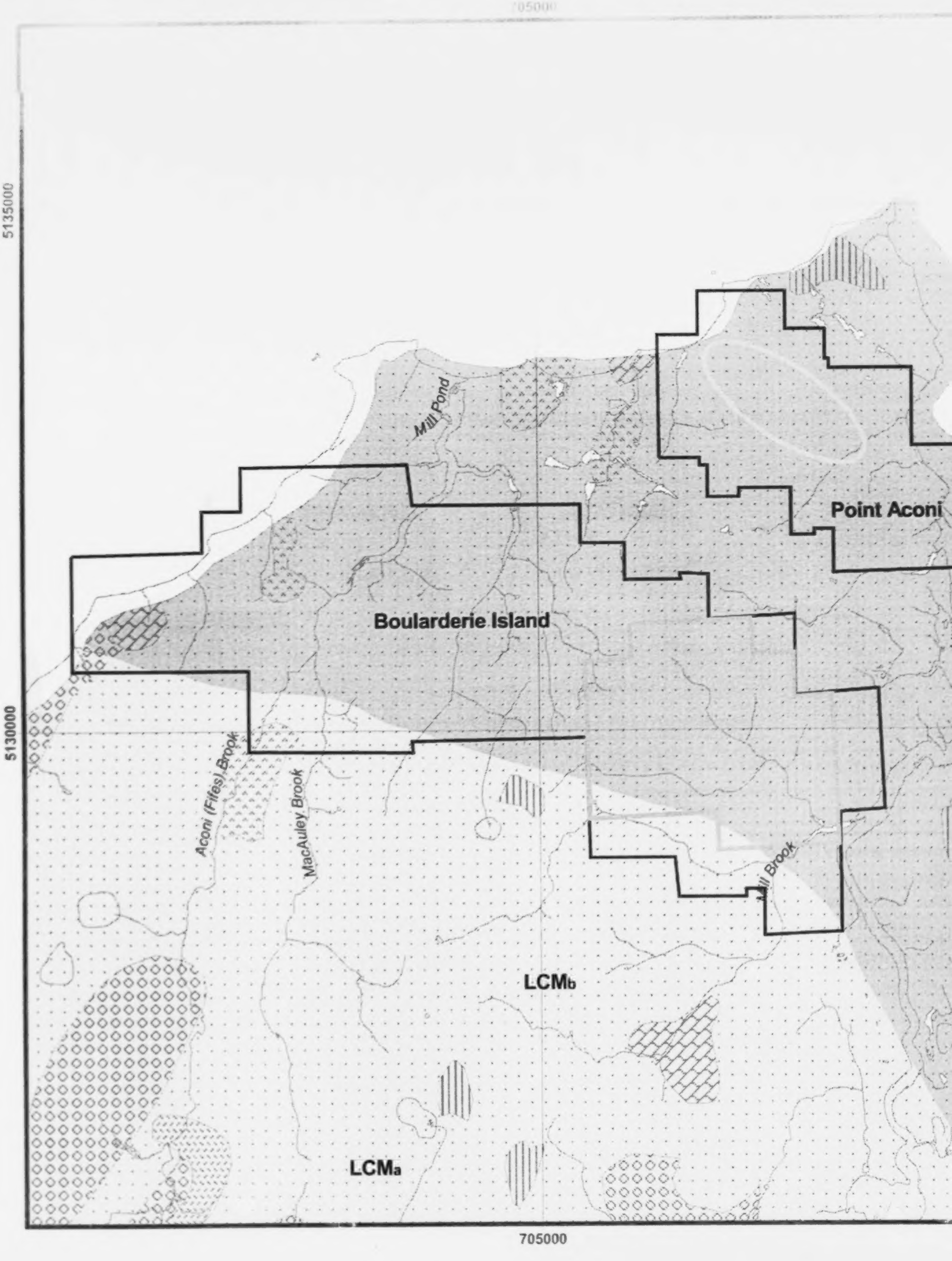
The following discussion is derived from several regional hydrogeological assessments of the Coal Fields areas (Baechler 1986), Frost 1964, and specific investigations of the flooded coal mines in the vicinity of Glace Bay (MGI *et al.* 2002; MGI *et al.* 2003), and other site specific studies relevant to the groundwater resources of Cape Breton County.

5.4.4.1 Overview of Existing Conditions

Hydrogeological Setting

The hydrogeology of the Cape Breton Coal Fields was described in a NSDEL regional hydrogeology report (Baechler 1986).

The four study areas are underlain by upper Carboniferous aged Morien Group bedrock that consists of a progressive alluvial succession up to 1200 m thick (Giles 1983) (Figures 5.7A and 5.7B). The Morien bedrock group is similar to the Pictou-Stellarton Group coal-bearing bedrock in Pictou County, and consists of three distinct sedimentary facies, differentiated by the dominant fossil content: a lower coarse permeable unit with predominantly grey conglomerate, arkosic sandstone, shale and minor coal seams (Lonchopteris Zone); a middle (Linopteris obliqua) group with grey arkosic sandstone unit with less shale and conglomerate, and minor coal beds; and an upper less permeable, coal shale unit (Ptychocarpus unitus zone) with grey sandstone and shale, thin freshwater limestone beds, and significant coal beds.


705000
5135000
5130000
Mill Pond
Point Aconi
Boularderie Island
Aconi (Fifes) Brook
MacAuley Brook
Mill Brook
LCMb
LCMa
705000

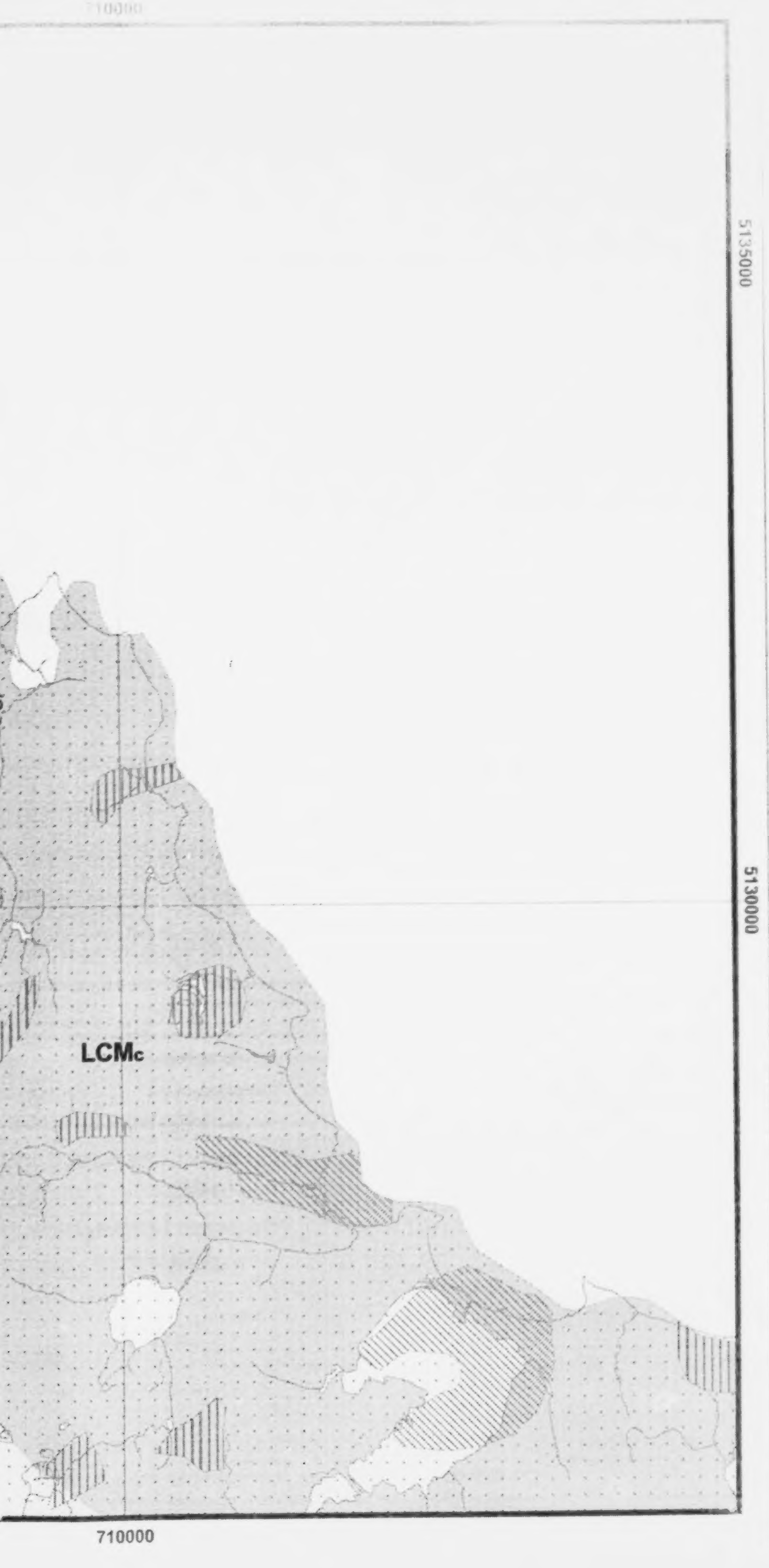


Figure 5.7A

Point Aconi and Boularderie Island Surface Coal Resource Blocks Geology

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:45,000
Project No.: NSD19669
Date: September 7, 2005

Surficial Cover

Post Last Glaciation (Holocene)
Organic Deposits

▥ Sphagnum moss, peat, gyttia, clay

Last Glaciation (Wisconsinian)

Glaciofluvial Deposits - Kame fields and Esker Systems

▨ Gravel, sand and silt, diamicton layers, poorly to well bedded, horizontal to angular beds, faulting and collapse features common

Ground Morraine and Streamlined Drift - Stony Till Plain

⋯ Stony, sandy matrix, material derived from both local and bedrock sources

Ground Morraine and Streamlined Drift - Silty Till Plain

◇ Silty, compact, material derived from both local and distance sources

Ground Morraine and Streamlined Drift - Silty Drumlin

⋯ Siltier till, higher percentage of distance source material including red clay

Bedrock Geology

Lonchopteris Zone Formation

LCMa grey sandstone, conglomerate, shale, coal

Linopteris Obliqua Zone Formation

LCMb grey sandstone, shale, coal

Linopteris Obliqua Zone Formation

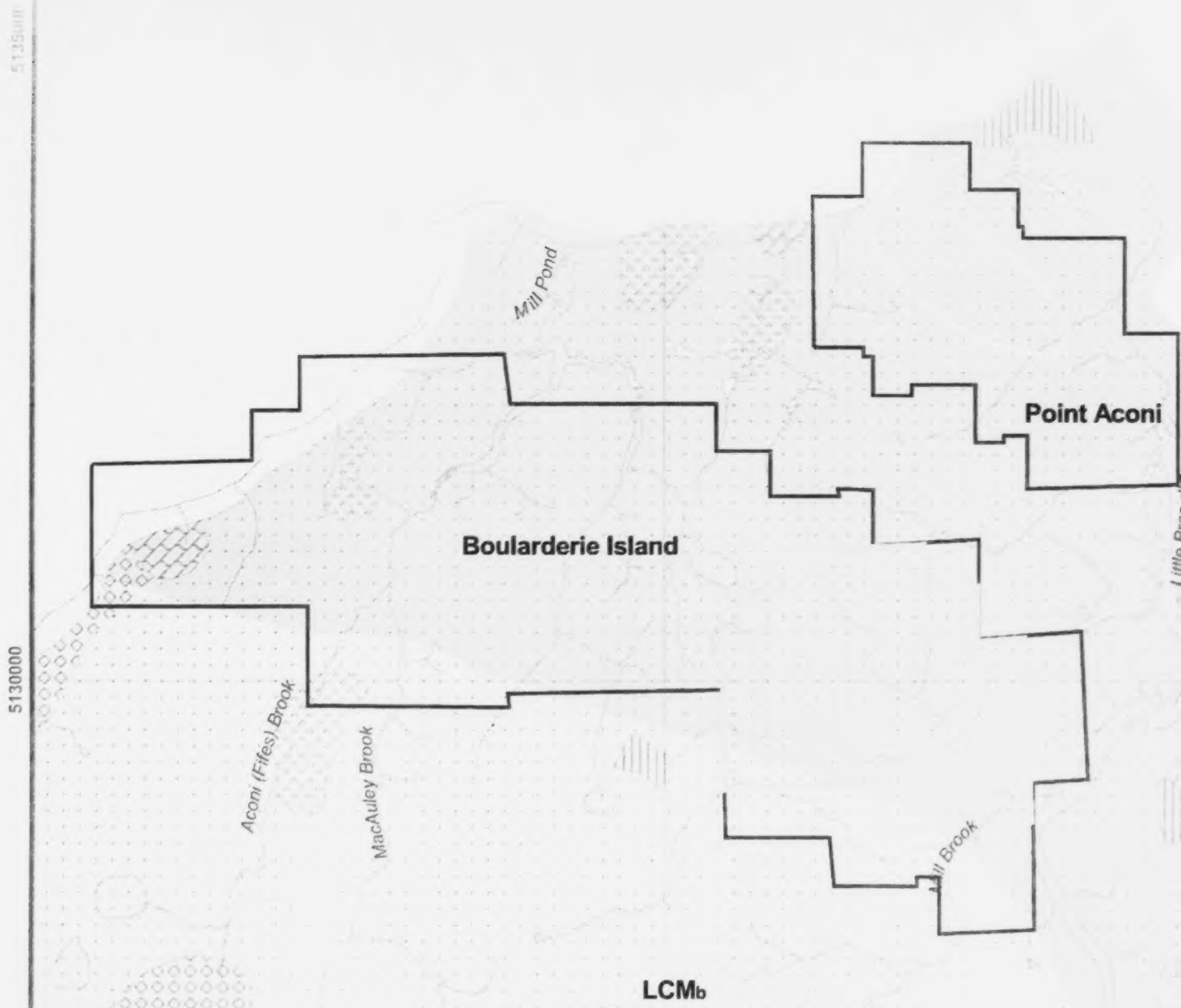
LCMc sandstone, shale, coal, limestone

Data Source:
D00-01 Geological Map of the Province of Nova Scotia, version 1, 2000, compiled by J.D. Keppie, 2000, scale 1:500 000.

D92-03. Surficial Geology Map of the Province of Nova Scotia, version 1, 1997, compiled by R. R. Stea, H. Conley and Y. Brown, 1992, scale 1:500 000.

NOVA SCOTIA
Environment and Labour

Jacques Whitford


5135000
Mill Pond
Point Aconi
Boularderie Island
5130000
Aconi (Fifes) Brook
MacAuley Brook
Mill Brook
LCMb
LCMa
705000

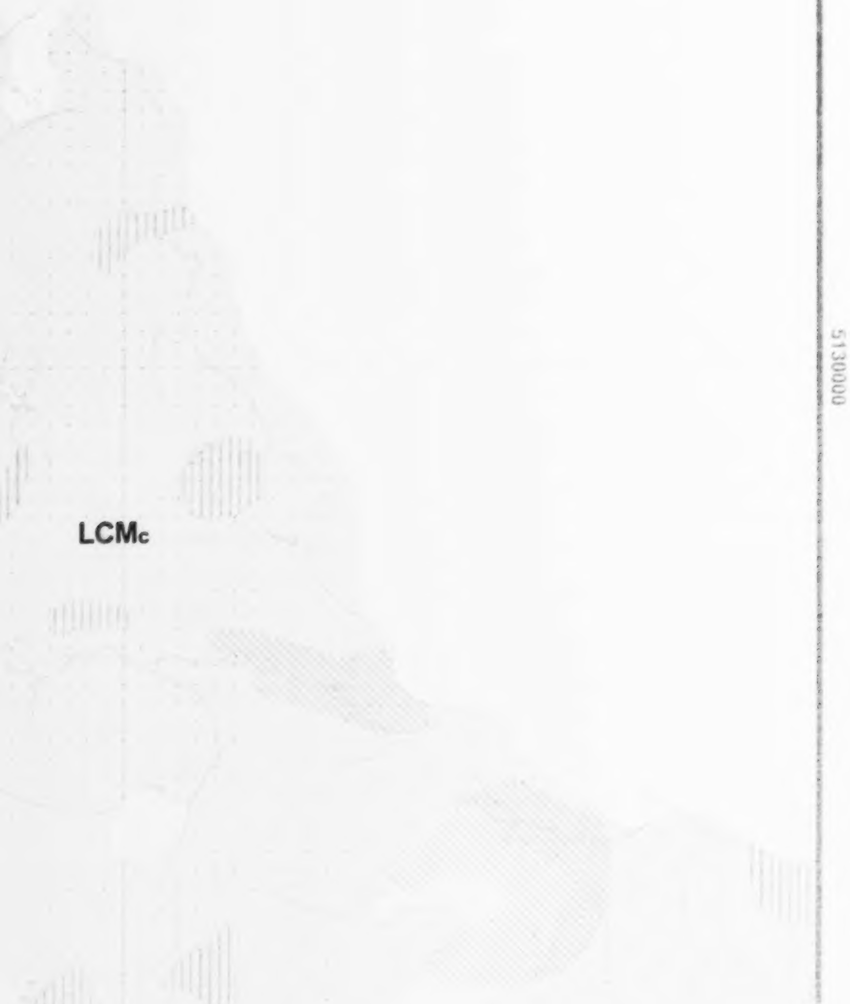


Figure 5.7A

Point Aconi and Boularderie Island Surface Coal Resource Blocks Geology

1 0 1 2

Kilometers

N

Map Parameters
Projection: UTM-NAD83-Z20
Scale - 1:45,000
Project No.: NSD19669
Date: September 7, 2005

Surficial Cover

Post Last Glaciation (Holocene)

Organic Deposits

- ▥ Sphagnum moss, peat, gyttia, clay

Last Glaciation (Wisconsinian)

Glaciofluvial Deposits - Kame fields and Esker Systems

- ▨ Gravel, sand and silt, diamicton layers, poorly to well bedded, horizontal to angular beds, faulting and collapse features common

Ground Morraine and Streamlined Drift - Stony Till Plain

- Stony, sandy matrix, material derived from both local and bedrock sources

Ground Morraine and Streamlined Drift - Silty Till Plain

- Silty, compact, material derived from both local and distance sources

Ground Morraine and Streamlined Drift - Silty Drumlin

- Siltier till, higher percentage of distance source material including red clay

Bedrock Geology

Lonchopteris Zone Formation

LCMa grey sandstone, conglomerate, shale, coal

Linopteris Obliqua Zone Formation

LCMb grey sandstone, shale, coal

Linopteris Obliqua Zone Formation

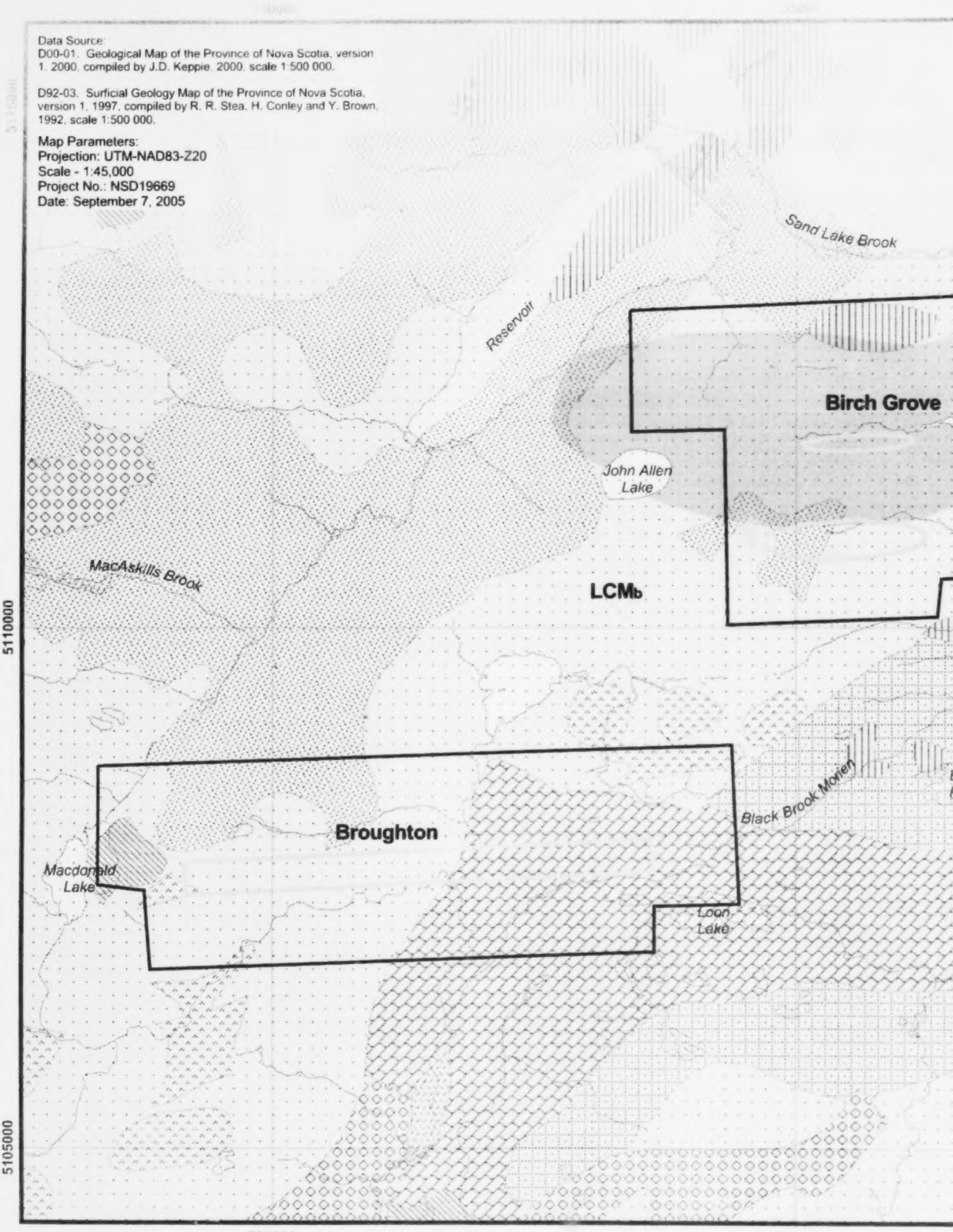
LCMc sandstone, shale, coal, limestone

Data Source:
D00-01. Geological Map of the Province of Nova Scotia, version 1, 2000, compiled by J.D. Keppie, 2000, scale 1:500 000.

D92-03. Surficial Geology Map of the Province of Nova Scotia, version 1, 1997, compiled by R. R. Stea, H. Conley and Y. Brown, 1992, scale 1:500 000.

NOVA SCOTIA
Environment and Labour

Jacques Whitford



Sand Lake Brook
Reservoir
Birch Grove
John Allen Lake
MacAskills Brook
LCMb
Broughton
Black Brook Morien
Macdonald Lake
Loon Lake
5115000
5110000
5105000
730000
735000

Data Source:
D00-01. Geological Map of the Province of Nova Scotia, version 1, 2000, compiled by J.D. Keppie, 2000, scale 1:500 000.

D92-03. Surficial Geology Map of the Province of Nova Scotia, version 1, 1997, compiled by R. R. Stea, H. Conley and Y. Brown, 1992, scale 1:500 000.

Map Parameters:
Projection: UTM-NAD83-Z20
Scale - 1:45,000
Project No.: NSD19669
Date: September 7, 2005

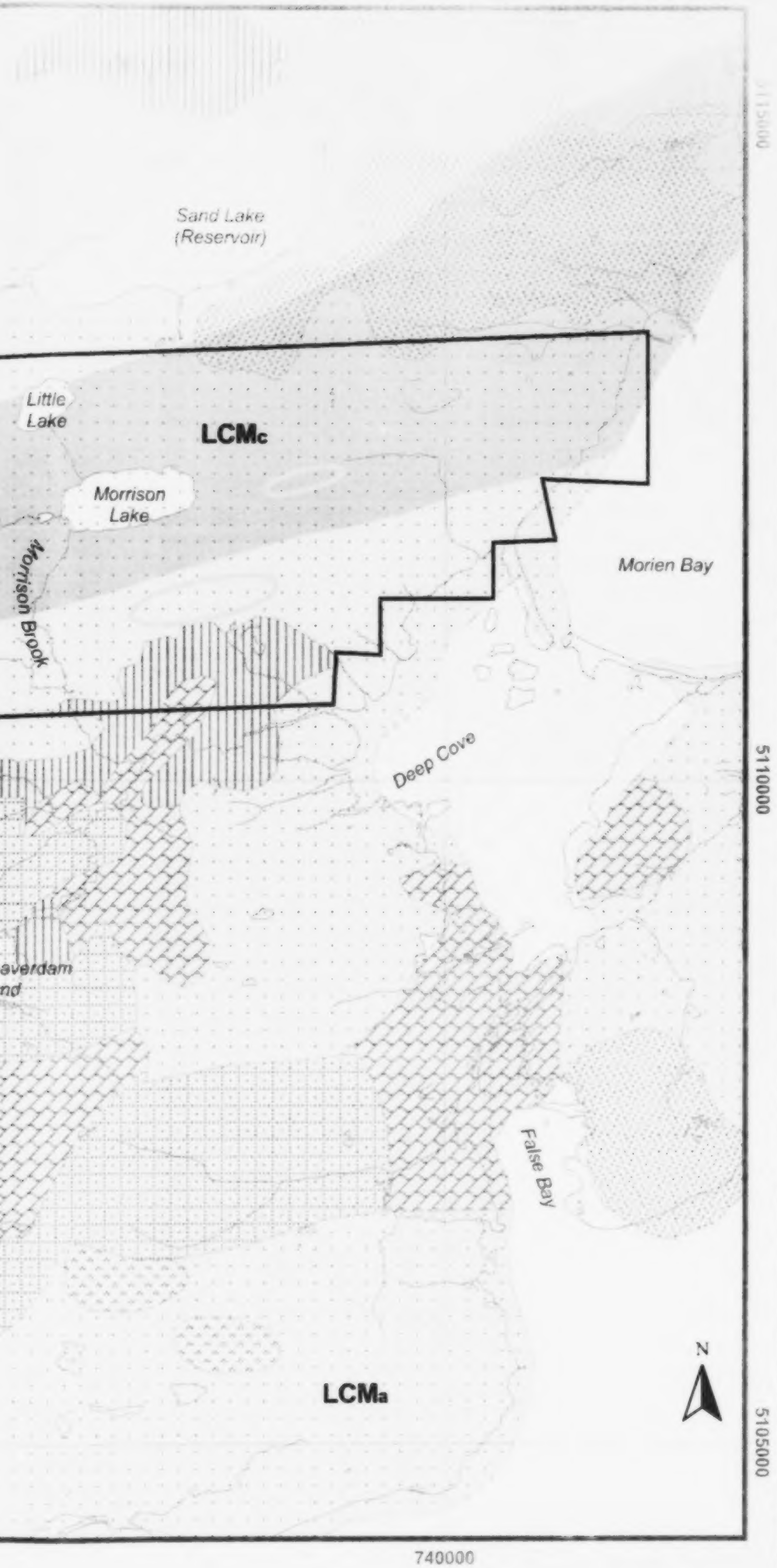


Figure 5.7B

Birch Grove and Broughton Surface Coal Resource Blocks Geology

1 0 1 2
Kilometers

Surficial Cover

Post Last Glaciation (Holocene)
Organic Deposits

▥	Sphagnum moss, peat, gyttia, clay

Alluvial Deposits

░	Gravel, sand, mud; bedded coarse at base, finer at top, stream channels generally gravelly sand, flood plains sand

Last Glaciation (Wisconsinian)
Glaciofluvial Deposits - Outwash fans, Deltas, and Valley Train Deposits

▦	Gravel and sand; massive to horizontally stratified, coarse to fine gradation within sections and deposits

Glaciofluvial Deposits - Kame fields and Esker Systems

▧	Gravel, sand and silt, diamicton layers, poorly to well bedded, horizontal to angular beds, faulting and collapse features common

Ground Moraine and Streamlined Drift - Stony Till Plain

☐	Stony, sandy matrix, material derived from both local and bedrock sources

Ground Moraine and Streamlined Drift - Silty Till Plain

◇◇◇	Silty, compact, material derived from both local and distance sources

Ground Moraine and Streamlined Drift - Silty Drumlin

░	Siltier till, higher percentage of distance source material including red clay

Pre Last Glaciation
Rock - Bedrock

░	Bedrock of various types and ages; glacially sources basins and knobs, overlain by thin, discotinuous veneer of till

Other

▨	Lakes

Bedrock Geology

Lonchopteris Zone Formation
LCMa grey sandstone, conglomerate, shale, coal

Linopteris Obliqua Zone Formation
LCMb grey sandstone, shale, coal

Linopteris Obliqua Zone Formation
LCMc sandstone, shale, coal, limestone

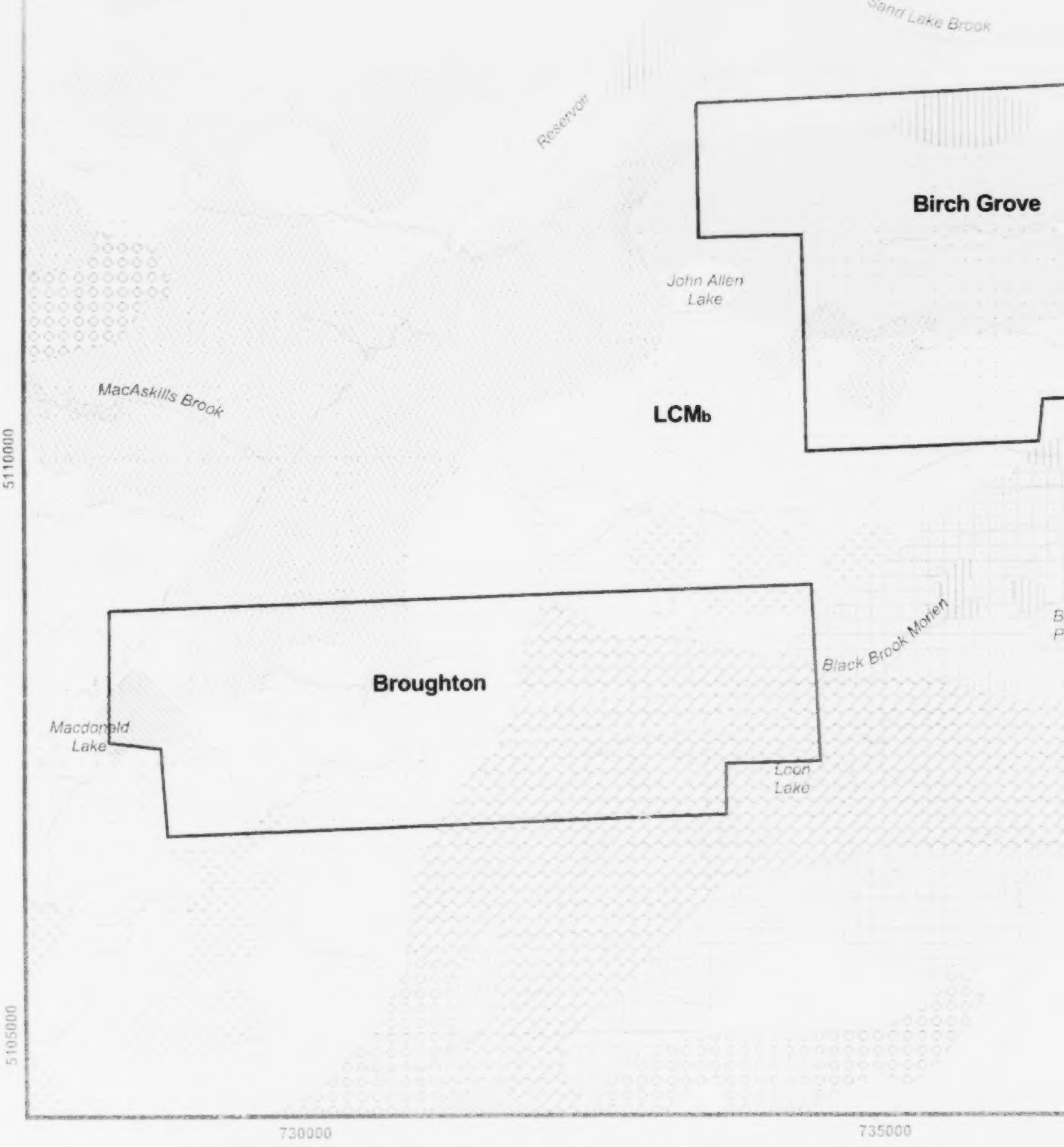
NOVA SCOTIA
Environment and Labour

Jacques Whitford

Data Source:
D00-01. Geological Map of the Province of Nova Scotia, version 1, 2000, compiled by J.D. Keppie, 2000, scale 1:500 000.

D92-03. Surficial Geology Map of the Province of Nova Scotia, version 1, 1997, compiled by R. R. Stea, H. Conley and Y. Brown, 1992, scale 1:500 000.

Map Parameters:
Projection: UTM-NAD83-Z20
Scale - 1:45,000
Project No.: NSD19669
Date: September 7, 2005


Sand Lake Brook
Reservoir
Birch Grove
John Allen Lake
MacAskills Brook
LCMb
5110000
Black Brook Morien
Broughton
Macdonald Lake
Loon Lake
5105000
730000
735000

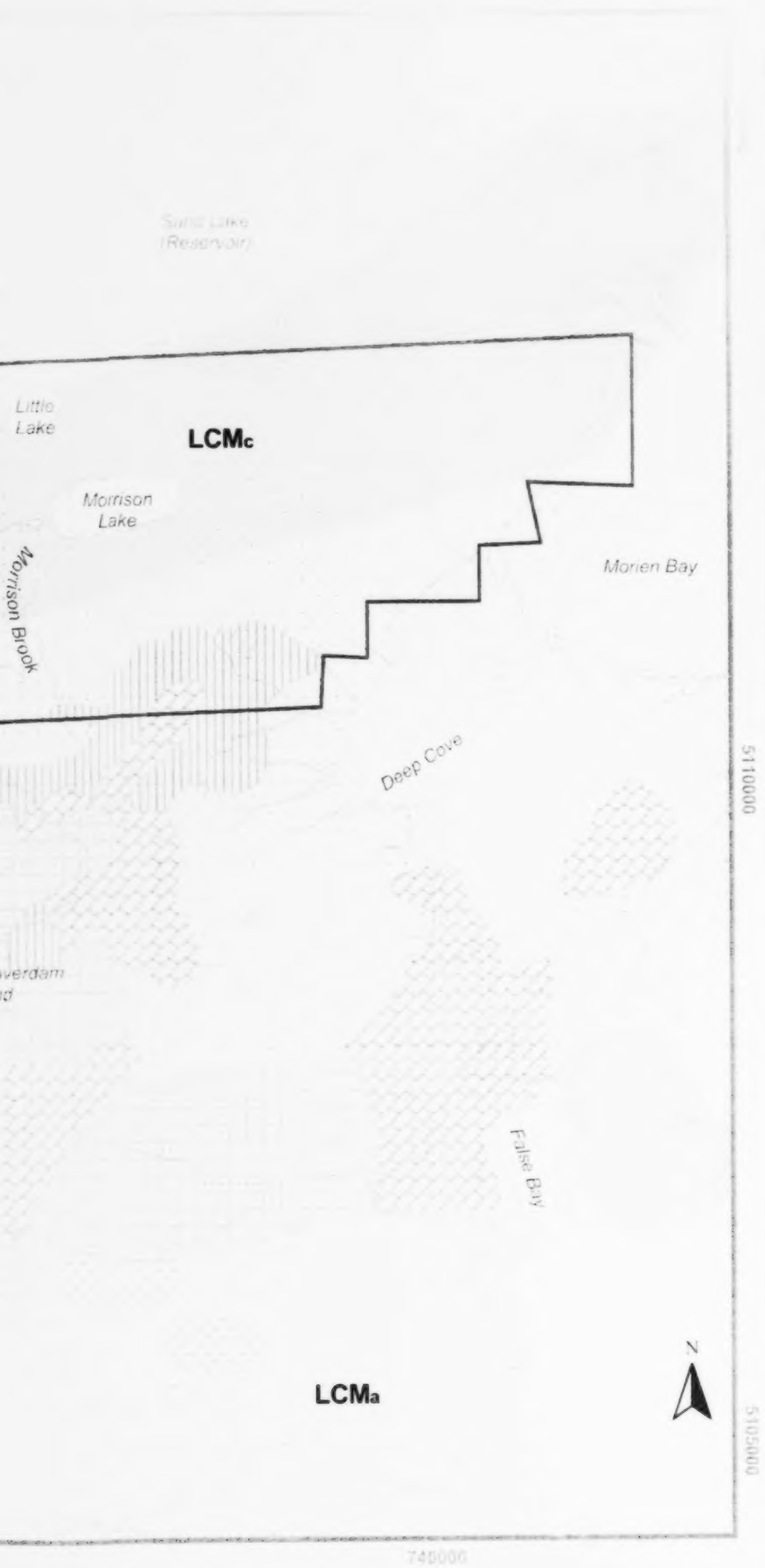


Figure 5.7B

Birch Grove and Broughton Surface Coal Resource Blocks Geology

1 0 1 2
Kilometers

Surficial Cover

Post Last Glaciation (Holocene)

Organic Deposits

Sphagnum moss, peat, gyttia, clay

Alluvial Deposits

Gravel, sand, mud; bedded coarse at base, finer at top, stream channels generally gravelly sand, flood plains sand

Last Glaciation (Wisconsinian)

Glaciofluvial Deposits - Outwash fans, Deltas, and Valley Train Deposits

Gravel and sand; massive to horizontally stratified, coarse to fine gradation within sections and deposits

Glaciofluvial Deposits - Kame fields and Esker Systems

Gravel, sand and silt, diamicton layers, poorly to well bedded, horizontal to angular beds, faulting and collapse features common

Ground Morraine and Streamlined Drift - Stony Till Plain

Stony, sandy matrix, material derived from both local and bedrock sources

Ground Morraine and Streamlined Drift - Silty Till Plain

Silty, compact, material derived from both local and distance sources

Ground Morraine and Streamlined Drift - Silty Drumlin

Siltier till, higher percentage of distance source material including red clay

Pre Last Glaciation

Rock - Bedrock

Bedrock of various types and ages; glacially sources basins and knobs, overlain by thin, discotinuous veneer of till

Other

Lakes

Bedrock Geology

Lonchopteris Zone Formation

LCMa grey sandstone, conglomerate, shale, coal

Linopteris Obliqua Zone Formation

LCMb grey sandstone, shale, coal

Linopteris Obliqua Zone Formation

LCMc sandstone, shale, coal, limestone

NOVA SCOTIA
Environment and Labour

Jacques Whitford

The bedrock Lithology becomes progressively finer-grained and geologically younger with more workable coal seams in a northerly direction. The Upper unit is characterized by poor groundwater quality, moderate to low well yield potential and mineable coal beds, and is referred to as the Upper Morien Group. The lower two units are characterized by good water quality, relatively high well yield potential, and poor coal development potential, and are collectively referred to as the Lower Morien Aquifer. The majority of the coal mines and coal seams are situated within the Upper Morien bedrock unit. The majority of the high capacity (> 1000 L/min) production wells are situated within the Lower Morien aquifer.

The Lower Morien Formation, estimated to exceed 500 m in thickness (Giles 1983), ranges from cobble conglomerate to pebbly sandstone, overlain by medium to thickly bedded grey sandstone, minor, discontinuous grey shale and very minor coal, all with interspersed lenses of conglomerate.

The Upper Morien conformably overlies Lower Morien strata and is in excess of 600 m in thickness. The characteristic rock types include grey shale, silty shale with associated economic coal seams and minor grey sandstones.

The structure of the Morien Group bedrock is controlled by a series of northeast dipping anticlines and synclines, interspersed by bedrock faulting.

Glacially derived, surficial sediment cover in the area consists generally of sandy and stony till and silty sand till, with a low clay content, ranging in thickness from less than two metres to four metres (Grant 1988) (Figures 5.7A and 5.7B). Ice-content stratified drifts, including kames, kame moraines and eskers, are present.

The Upper and Lower Morien aquifers exhibit significantly different hydraulic properties. A review of the NSDEL pumping test inventory (1965 to 2005) indicates that the Lower Morien sandstone unit has significantly higher well yield potential (about 15 times) than the Upper Morien Coal shale units. A comparison of mean values is shown below in Table 5.5.

TABLE 5.5 Well Characteristics in Upper and Lower Morien

Parameter	Upper Morien (N = 3)	Lower Morien (N = 24)
Mean Well Depth (m)	35.8	71.2
Casing Length (m)	13.9	12.9
Static Water Level (m)	5.7	6.0
Well Transmissivity (m^2/d)	4.2	21.6
Specific capacity (m^3/d/m)	2.95	45.6
Sustainable Yield (L/min)(igpm)	25.0 (5.5)	338.2 (7.4 IGPM)
Aquifer Transmissivity (m2/d)	-	81.4 (N=14)
Storativity (units)	-	3 x 10-4 (N=14)

Baechler (1986) describes the general groundwater quality of the Upper and Lower Morien bedrock units. Groundwater quality in the Lower Morien aquifer is considered to be good to excellent. The water is described as a soft to moderately hard, predominantly calcium bicarbonate water with a pH in the vicinity of 7.0 to 8.0. Hardness, pH, and TDS were generally found to increase with depth due to dissolution of carbonate along the flow path. Iron is generally low, but manganese often exceeds the 0.05 mg/L Canadian Drinking Water Guideline (Health Canada 20 04).

Groundwater chemical quality in the Upper Morien aquifer can range from good to very poor, depending on the degree of coal shale encountered by a well. The well water is described as moderately hard and alkaline, calcium-bicarbonate water with all parameters except iron and manganese usually within drinking water guidelines. Deep wells in the presence of coal-bearing units may exhibit elevated hardness, sodium and chloride, sulfate, iron, manganese, strontium, barium, and ammonia concentrations, and occasional hydrogen sulfide odors. Methane is rare, but could occur if abandoned mine workings are near a well.

On a regional scale of several kilometres, groundwater flow is expected to follow topography, from points of recharge in upland areas, to points of discharge along streams, wetlands and lakes, and the sea coast. The dominant surface water and groundwater flow direction would be expected to be to the east and the Atlantic Ocean.

Groundwater recharged from rain fall moves vertically downward through the overburden and into the underlying bedrock, then flows horizontally in the dominant direction of groundwater flow through secondary or fracture permeability developed in the more competent bedrock strata; only minor intergranular flow is provided from primary porosity in the coarse-grained sediments.

This regional groundwater flow pattern may be disrupted or dominated by abandoned mine workings, which act as secondary permeability in the bedrock. Ground subsidence and increased shallow bedrock fracturing associated with underground workings near coal seam sup-crop areas results in increased rates of vertical infiltration, and a drain effect if workings are not saturated. A sub-crop is the surface expression of a bedrock unit, and can extend several hundred me tres in width, and kilom etres horizontally along bedrock strike.

The Lower Morien Group bedrock is typified by predominantly sandstone units of considerable thickness. The Point Aconi aquifer is the best aquifer in the Sydney Coal Fields and has been designated a "Class I" aquifer in a regional aquifer assessment by Shawinigan (1980), providing both good yields and excellent water quality to drilled wells. Properly located and designed water wells in the Lower Morien can yield in excess of 500 Lpm, and the average bedrock transmissivity was greater than 200 m^2/d.

Point Aconi Block

The proposed mine site is underlain by the Upper Morien bedrock group, which consists of grey shale, silty shale with associated economic coal seams and minor grey sandstones. The Georges River Fault approaches the study area from the south, creating the straight north-west oriented shoreline on the northern most portion of St. Andrews Channel. The bedrock is folded into a series of northeast dipping anticlines and synclines, including the Point Aconi Syncline through the site, and the Boisdale Anticline located west of the site (Baechler, 1986, Robertson & Assoc. 1975). The local bedrock strike is northwest, and dip appears to be to the northeast at about 2 to 4 degrees.

Overburden consists of silty sand glacial till with low clay content, ranging in thickness from less than two metres to four metres (Grant 1988). The NSDEL mapping (Baechler 1986) indicates 3.6 to 9.8 m, mean 5.6 m of till thickness. Ice-content stratified drifts, including kames, kame moraines and eskers, are locally present.

The Point Aconi site will mine the Hub Seam outcrop, which is the topmost seam. The Hub seam was originally mined from1861 to 1875 when it was closed due to fire and from 1903 to 1919 by Dominion Coal Company with a 36.5 m deep shaft at Table head (Frost 1964). This colliery had an average of 1.4 m thick coal, and extended 9000 ft seaward, and included mining of the approximate 0.5 square mile section on land (possible subsidence risk). The mine is now flooded at least to sea level (JWEL 1993). Several collapse features, and sea water intake tunnels associated with the Hub seam are known to occur in the Table Head to P oint Aconi area.

Based on topography, local groundwater and surface water flow directions are northwest and northeast from the topographic high at the power plant towards the coastline. The elevation of the piezometric surface at the NSPI Power station ranged from 33 m to 52 m (JWA 1993). It appears that the major source of groundwater movement in the north-south direction is along the major fractures associated with the structural deformities.

Residents in the community of McCreadyville located along Point Aconi Road to the east side of the block (Figure 1.2A) rely on drilled wells for water supply. The nearest water supply wells are at the NSPI power plant and the community of McCreadyville. Three high capacity production wells with yields in excess of 2,300 L/min are present at the NSPI station. Based on a review of 86 NSDEL well drilling logs, domestic wells in the area are typically 155 mm diameter drilled wells with an average depth of 40.8 m, 11.8 m of casing, and reported yields in the range of 5 to 320 L/min, mean 50 L/min. Depth to water ranges from flowing above grade along the coasts, to 27.4 m on hills, averaging 7.2 m.

The main potential groundwater impacts from surface mining in this area is possible impacts to domestic wells along Highway 162 on the southeast and east portion of the block. These wells would be recharged from the vicinity of the Power Plant, and west of Highway 162. Mining on the northwest portion of the block should be less disruptive, however sea water intrusion into the excavation may be a concern. Depending on site conditions, acid-generating waste rock may be generated, and ARD impacts to surface water and groundwater may need to be implemented.

Subsidence issues need to be addressed northeast of the Hub seam. Unsaturated mine workings are known to occur in the vicinity of the power plant in the northwest areas.

Boularderie Block

The area is underlain by gray shale and sandstone, minor limestone, coal and coal-shale of the Upper Morien Group. The bedrock strike is southeast to northwest across the site, with a low dip of 4 to 5 degrees to the northeast. Overburden consists of silty sand to sandy silt glacial Till ranging in depth from 0 to 14 m, mean 5.8 m (Baechler, 1986). The contact with the underlying Lower Morien sandstone aquifer is located just south of the Phalen seam and the property boundary. The Lower Morien bedrock would be expected to underlie this site at depths of 30 to 200 m.

Three coal seams are present (Phalen, Indian Cove and Millpond). The Phalen seam was extensively mined in the Glace Bay and Lingan Basins. The Phalen coal is estimated to be 2.1 m thick (Frost 1964).

The majority of the proposed mine site is within Point Aconi brook watershed (1FJ-SD93, 4303 ha, with 38 ha of surface water). Based on topography, the dominant groundwater and surface water flow direction is east into a tributary of Little Bras D'Or Arm at Mill Creek, north into Point Aconi (Fifes) Brook estuary near table Head, and west to the coast at Great Bras D'Or.

The nearest residential water wells would be located along the highways between Millville on the south, Mill Creek on the east, and Black Rock to Mill Pond on the northwest and west. Refer to Figure 1.2A. A review of 265 NSDEL Well Driller's Logs indicates: well depths of 11.3 to 143 m, mean 45.6 m; casing length of 1.8 to 11.0 m; well yields of 3 to 1450 L/min, mean 13.0 L/min, depth to water ranging from flowing to 36.5, mean 11 m, and overburden thickness 0.6 to 18 m, mean 5.0 m.

The NSPI Point Aconi Power Plant well field is located along Highway 162 between Millville Boularderie and McCreadyville (JWA 1990). The three 200 mm diameter, 91 m deep production wells are completed in the underlying Lower Morien Group bedrock aquifer, and produce at a combined peak yield of 2,300 L/min (500 igpm). Two 16 day and 69 day duration pumping tests were performed to determine aquifer properties, and potential effects on residential wells in the area (JWA 1991). The Lower Morien aquifer has a conservative aquifer of 110 m^2/d, a storage coefficient of 4 x 10^{-4}.

The groundwater chemistry in the Lower Morien bedrock is considered to be good, and is described as moderately hard and alkaline, sodium chloride to calcium chloride water type, with all parameters except manganese meeting Guidelines for Canadian Drinking Water Quality (Health Canada 2004).

Subsequent monitoring of up to 500 domestic water supply wells in the area indicated a wide range of chemistry, depending on well age and construction, with common reports of elevated iron, manganese, salt, colour and odours.

The main issues with respect to surface mining in this area include potential dewatering of domestic wells located along the two roads between Millville-Boularderie and Mill Pond, and potential for interference with the Point Aconi Industrial Well Field located on Highway 162 at the east side of the block (refer to air photos in Appendix A). Note: There have been historical issues in the Millville area with respect to past surface coal mining operations by NOVACO (NSDEL/A. Cameron circa 1980-1885).

The interactions with the NSPI well field may be mitigated in that the proposed mining is limited to the Upper Morien coal-bearing bedrock. However, some hydraulic interaction could occur.

Depending on site conditions, acid-generating waste rock may be generated, and ARD impacts to surface water and groundwater may need to be implemented

Birch Grove Block

The Birch Grove mining block is underlain by grey sandstone and coal shale of the upper Morien Group. Bedrock structure is controlled by the Morien syncline, which strikes east-west through the block. Bedrock dips inward from the Spencer seam towards the syncline axis which underlies Birch Grove and passes north of Morrison lake. This syncline is asymmetrical, with steeper dip (30 to 45 percent) on the north limb, and 10 to 12 degrees on the south limb. This suggests that mining the north side would result in less ground disturbance than the south side.

Overburden consists of sandy silt to silty sand glacial till over the north half of the block, and a possibly more permeable hummocky glacial moraine complex overlying the south half (Baechler 1986). Test holes in the area indicate a till thickness in the order of 1.5 to 10 m, mean 4.2 m. Peat bogs are present southwest of Morrison Lake, and poorly drained conditions can be expected in the hummocky glacial terrain.

The Birch Grove site contains three coal Morien Coal Basin seams; the Spencer (1.1 m thick), the Gowrie (1.5 m thick) and the Trunnelshed (2.44 m thick), (Frost 1964).

The majority of the site is drained southeast through Morrison Lake to Black Brook meadow to Morien Bay. Based on bedrock structure, groundwater flow is expected to be east to Morien Bay, following the Morien syncline.

Glace Bay, Dominion, Reserve Mines and surrounding communities are serviced by Sand Lake and the MacAskills Brook Reservoir. Sand Lake is located 500 m north of the mining block and the MacAskills Brook Reservoir is less than 300 m from the northwest corner of the block. The rural community of Birch Cove is serviced with a water distribution system derived from John Allen Lake located 1.2 km southwest of Birch Cove, and 300 m from the southwest boundary of the mining block. Schooner Pond, located approximately 7 km northeast of the mining block, serves Donkin. These surface water supply systems are operated by the CBRM.

Unserviced residences in this area may utilize dug wells completed in overburden, or drilled wells completed into bedrock. The nearest residential water wells are located along the highway at the community of Birch Grove in the central west area of the block; at Port Morien at the coast on the extreme east end of the block, and along the highway between Port Morien and Birch Grove (Figure 1.2B).

A review of 77 NSDEL Well Driller's Logs at Port Morien, Morien, Morien Junction and Birch Grove indicates that bedrock wells are completed in Upper Morien sandstone and shale with depths ranging from 13.7 to 123.4 m, mean 44.8 m; 3.7 to 32.0 m, mean 9.9 m of 155 mm diameter casing, and yield from 2.3 to 1818, mean 95.3 L/min. Depth to water table ranges from flowing to 21.3 m, mean 6.4 m. The wells between Morien and Birch Grove exhibit similar statistics as the Port Morien wells.

Rural water wells in the vicinity of Birch Grove could be at risk from water level lowering if major development occurs on the Gowrie seam. It may be feasible to mitigate some of these concerns by hooking the residences to the Birch Grove distribution system. However, major parts of the seam have been mined historically and not likely to be surface mined. Wells along the highway at Morien and Morien Junction could be affected by mining on the Tunnelshed seams.

Depending on site conditions, acid-generating waste rock may be generated, and ARD impacts to both surface water and groundwater may need to be implemented.

The mining block is less than one kilometre from three water supply reservoirs. Attention would be needed to prevent any effects on these water bodies, including effects on water levels and from sediment and acid runoff.

Morrison Lake is in the middle of the site, and would need to be protected from mining operations.

Broughton Block

The Broughton mining block is underlain by grey conglomerate, arkosic sandstone, shale, a few red beds, and minor coal seams of the Lower Morien Groups. Contact between the Lower Morien and Middle Morien occurs immediately north of the Tracey Coal Seam. The bedrock strike is almost east-west, dipping about 10 degrees towards the north.

Overburden consists of sandy silt to silty sand glacial till over the northwest third of the block; more permeable hummocky glacial moraine complex overlying the central third, and outwash sand and gravel materials on the extreme southeast corner of the block (Baechler 1986). Test holes in the area indicate a till thickness in the order of 0.6 to 2.1 m in the vicinity of Morrison Road, and 5 m or more in the vicinity of the sand and gravel complex. The water well driller's logs indicate an average till depth of 5.9 m. Some sand and gravel quarries are present in the outwash deposits on the southeast corner of the block.

Two coal seams sub-crop in the Broughton block: the Tracey (1.5 m thick) and MacDonald Lake seams.

The proposed mine area is situated within the Black Brook watershed (1FJ-SD31, Area 2399 ha, with 82 ha covered by lakes). Based on topography, surface water and groundwater flow should be south towards Loon Lake and Black Brook Mira sub-watershed that drains Cochrane Lake.

Water supply wells in this area may be dug wells completed in overburden, or drilled wells completed into bedrock. The nearest residential water wells would be located along the highway at the community of Broughton on the northeast corner of the block, and possibly along Morrison Road crossing the northwest corner of the block (Figure 1.2B). A review of 9 NSDEL Well Driller's Logs at the Broughton area indicates: that bedrock wells are completed in sandstone with depths ranging from 9.1 to 92.3 m, mean 44.9 m; from 6.1 to 12.2 m, mean 9.0 m of 155 mm diameter casing, and yield from 18 to 91, mean 40.7 L/min. Depth to water table ranges from 2 to 8.5 m, mean 7.0 m.

Residential well development appears to be sparse in this area. The main potential receptors are located along Morrison Road in the northwest corner of the block. Surface water control may be the main issues, with set-backs or diversions needed for Loon and MacDonald Lakes, and Black River Mira.

Depending on site conditions, acid-generating waste rock may be generated, and ARD impacts to surface water and groundwater may need to be implemented.

5.4.4.2 Effects Assessment and Mitigation

Effects

Surface coal mining can have an adverse effect on local groundwater resources. Effects may be both physical, such as water table lowering with possible loss of supply, or chemical, such as acid drainage or temporary to permanent degradation in aquifer water quality. Typical effects from surface coal mining could include:

- Water table lowering and consequent reduced yield to water wells;
- Changes in groundwater chemistry in the vicinity of and hydraulically down-gradient of the open pit mine;
- Temporary water discoloration in wells due to vibration and blasting;

- Partial or complete collapse of older water wells due to blasting or land subsidence; and
- Land subsidence caused by changes in pore pressure from dewatering.

Lower water tables in the vicinity of domestic water wells could theoretically result in insufficient yield for the residence. This is more likely to occur for low yield, very shallow (< 30 m) wells where the combination of yield and in-well storage cannot sustain a reduction in water level (either due to natural seasonal decline or mine-induced decline). Deeper wells would be expected to be better capable of handling minor water level declines caused by mine dewatering.

Groundwater levels in the vicinity of the proposed mine sites typically averaged 7 m below grade. Assuming an average mining cut-off depth of 60 m (200 ft), the water table will need to be lowered by an estimated 53 m in the vicinity of the excavation.

The magnitude of water table lowering at a domestic well would be expected to be proportional to several factors, including:

- distance from the mine,
- direction with respect to groundwater flow directions and bedrock structure (down-stream along strike more likley to be impacted);
- hydraulic properties of the intervening bedrock (higher permeability results in greater impact);
- proximity to abandoned flooded mine workings in hydraulic connection with mine; and
- well construction (depth, yield, pump intake, pumping rates).

If the surface mine encounters abandoned flooded mine workings, then the associated audits and rooms would also become dewatered to that depth, and could affect more distance wells located near such workings. This was observed at Westville during a Mine water geothermal feasibility test when the Pioneer coal surface mine was in operation (JWEL, 1992).

In general, negligible adverse affect (defined as < 1 m of water level decline in a drilled well) is expected to occur at distances greater than 500 m from a surface mine site. Monitoring, hydraulic testing and possible groundwater modeling would be needed to better assess distance-drawdown potentials. It is assumed that this detailed risk assessment would take place during the project specific environmental assessment.

The most significant concern with respect to water quality is ARD. ARD is the product formed by the atmospheric oxidation of the relatively common iron-sulphur minerals pyrite (FeS_2) and pyrrhotite (FeS) in the presence of bacteria (*Thiobacillus ferrooxidans*). The end product of this reaction is ferric acid and ferric sulphate, which can significantly lower the pH (increase the acidity) of the discharge water. The lower pH can often mobilize metals present in the rock.

While this is a naturally-occurring process, significant disruption of these minerals during mining and the exposure to air of rock that was previously located below the water table can dramatically increase the rate of reaction and thereby create ARD. Downgradient surface and groundwater resources can be affected without mitigation.

ARD associated with waste rock piles and exposed rock cuts has been documented at numerous sites across Cape Breton.

Blasting activities can affect water wells in two main ways. Temporary discoloration of well water can be caused by shock waves that disturb any precipitate and sediment located in the well. This typically only affects the aesthetics of the well and is a temporary effect that can be easily monitored. Shock waves can occasionally induce new fractures in bedrock aquifers and these have been known to permanently change water quality and sometimes lower the water level in a well. Pre-blast surveys and monitoring are commonly used as mitigation.

Other possible effects include land subsidence caused by withdrawal of store water from old abandoned mine workings. Land subsidence in the vicinity of abandoned coal mines is a common occurrence throughout the coal basins in Nova Scotia. Several occurrences have been documented in the Glace Bay, Stellarton and Westville area; it is noted that these events occurred prior to surface coal mining. Subsidence is caused by deformation (expansion of overlying bedrock as a mining void collapses at depth. The magnitude of subsidence is generally proportional to the size of the void closure, whether or not the void is flooded, and the distance between the void and the surface. In general, most subsidence events are related to shallow (< 30 m deep) mine voids, and tend to occur close to and hydraulically down-gradient of the coal seam sub-crop with the surface.

Theoretically, any change in pore water pressure can lead to subsidence. If the mined area is flooded, and then dewatered, the upward pressure afforded by water is removed, and collapse can occur. Also, ancient on-land workings and bootleg mines that were dry for centuries, could also collapse as flood waters dissolve minerals and rotted wood timbers in the workings.

Mitigation

There are generally two main types of mitigation available to address the potential effects note above. The primary form of mitigation is to prevent or reduce the known effect during mining. These mitigations could include:

- Reducing the area and time required for dewatering, or lessening the off-site effects of the dewatering by timing mining activities during lower-risk periods of the year;
- Detailed hydraulic assessment of the mining activity including the assessment of any old mine workings;

- Preventing the chemical reaction that causes ARD by maintaining the minerals below the water table or safely containing them in an Engineered Land Form (ELF);
- Careful control of blasting activities; and
- Subsidence risk assessments and preventive works where subsidence is predicted to cause adverse effects. Preventive works can include hydraulic controls to keep old workings flooded during mining.

The secondary form of mitigation includes restoration or replacement of any damaged wells. In the unlikely event of a serious adverse effect on a domestic water supply wells, several mitigative options are available to restore or replace the supply to the satisfaction of the owner:

- Monitoring to detect onset of a water level impact;
- Well Rehabilitation (deepening);
- Well replacement;
- Provision of temporary water storage tanks and regular re-supply;
- Provision of Central water supply well(s) for community;
- Connection to municipal services where practical;
- Purchase and removal of the affected property; and
- A detailed mitigation program is typically developed during the project specific environmental assessment.

Several of these mitigative measures are described further below.

The most common rehabilitation measure is to simply deepen a shallow well until there is a sufficient combination of yield and in-well storage to sustain residential demands. Work would typically involve:

- Assessment of the well yield, depth, and water levels by a hydrogeologist;
- Removal of the existing pump and controls;
- Drilling the well at least 15 m deeper using a registered well driller;
- Develop the well and confirm yield;
- Reinstallation of pumping equipment; and
- Confirm yield and water quality with a short (4-8 hr) pumping test.

Associated works may involve provision of in-house storage tanks for low yield situations, water treatment, and/or temporary water during the rehabilitation work.

In some cases, such as where a well cannot be accessed for rehabilitation, or economically repaired, it may be economically advantageous to replace an affected well with a new, deeper, properly constructed water well.

In the event that several adjacent home owners are affected by water level decline, it may be advantageous to install a community water supply outside of the affected area, and connect residents to a central water supply system. This scenario would involve a phased hydrogeological investigation, including:

- Assessment of well locations;
- Supervision of a minimum of two exploration wells;
- Development and hydraulic testing of a minimum of one production well (with the second well as a back-up well);
- Provision of pumping, pipeline, storage and metering;
- Water quality treatment as required (minimum of disinfection); and
- System maintenance and monitoring as a public water supply.

In some cases, it may be feasible to provide a large storage tank and provide regular fill up with quality municipal water. While this would not be considered as a permanent option, it may be be an interim option in some situations. The storage could be installed in a basement or buried in the ground, and should be of sufficient capacity to provide at least one week of supply (*e.g.*, about 7000 L (2000 igal) assuming 1000 L/day/residence) (most 4 person residences use, 200 igal per day).

Where practical, an effective approach is to connect the affected residents to the local municipal water supply distribution system. None of the four proposed sites is close to a municipal system. This may be feasible for some wells near Birch Grove.

Depending on economics, a final option may be to purchase and remove affected properties.

Monitoring

Monitoring is an essential component of any risk management and claims adjudication planning. A detailed monitoring program is typically developed for the project specific EA.

Effective and continuous monitoring of groundwater levels and chemical quality in the vicinity of a surface coal mine is important. It is common practice to establish a series of groundwater monitoring wells within a few hundred metres of the mine excavation and between the mine area and the closest residential wells to monitor long term changes in groundwater levels. This is needed both for the assessment of regional aquifer dewatering, and also for mine safety considerations. For example, the stability of pit walls may be affected by pore water pressures, and knowledge of seasonal water levels and inflow rates and water chemistry will be useful in planning of mine dewatering requirements. Continuous records of aquifer water levels (e.g., groundwater level hydrographs) will provide an indication of the likelihood of water level declines in the vicinity of a domestic well, and also provide an indication of seasonal effects on water levels in the area.

The monitoring program would consist of several components, including:

- Baseline monitoring of nearby residential water wells;
- Mine sump (inflow quantity and quality) monitoring;
- Mine perimeter water level monitoring;
- Background water level monitoring (outside capture area of mine); and
- Representative residential well monitoring.

Ideally, there would be sufficient monitoring wells to establish a distance drawdown curve (mine sump, perimeter, a well between mine and community wells, and a community well).

In order to assess claims of property damage due to possible mine subsidence (in areas underlain by abandoned mine workings or boot-leg workings), it will be necessary to establish the present elevations and degree of historical subsidence, establish a series of strategic precision survey monuments, and to conduct regular elevation surveys during the course of the mining operation. For those sites with possible abandoned flooded mine workings, a subsidence risk assessment and monitoring program would include:

- Information review and identification of historical coal workings;
- Baseline elevations survey;
- Inspections of foundations, structures, etc. deemed to be at risk (similar to a pre-blasting survey);
- Establish elevation survey monitoring monuments; and
- Monthly (or as directed by regulators) surveys of elevations.

Subsidence mitigation is difficult, and would typically involve the relocation of affected residences. In minor cases, remedial repair and reinforcement may be options.

5.4.4.3 Summary of Residual Cumulative Effects

During operations, the main stressors on water resources at the proposed mine sites may include the following:

- Localized water table lowering during mine dewatering that could affect nearby water well users;
- Temporary aesthetic effects or permanent damage to wells from blasting; and
- Possible localized subsidence.

Common mitigation would involve monitoring water levels throughout the mining activity, and where required, refurbishment or replacement of any damaged wells.

During and after reclamation, residual effects could include slight groundwater quality changes caused by recharge through in-filled surface mine workings, and ARD. Wells or surface water bodies located hydraulically down gradient of the reclaimed mine could theoretically be affected. The most likely effect would include increased iron and manganese concentrations, and possible sulphate hardness from ARD. The degree of effect would be a function of in-fill material geochemistry (organic/coal content; sulfide content) and percolation rates.

Mitigation measures to be applied during mine reclamation could be segregation of in-fill materials by geochemistry, layering and compaction as infilling progresses, and use of drainage diversion and capping procedures.

Considerable expertise has been gained in surface coal mine reclamation in the US Mid-west, and elsewhere. Refer to Best Management Practices in Section 4.0.

Considering the potential for interaction of surface coal mining projects with water resources impacted from previous projects (*e.g.*, mining, subsidence), there is the potential to create significant adverse cumulative effects on water supply resources. However, none of these effects would be expected to be widespread, and the impact of these effects can be mitigated with proven technology. The mitigation would be expected to be successful and would be a requirement of the regulatory process. With mitigation, the potential for significant adverse effects on water resources would be reduced and the residual effects would likely not be considered to be significant. A more definitive assessment of the significance of residual cumulative effects on water supply resources and only be determined during project specific assessment. A program of monitoring would be needed to confirm the success of the mitigation.

There is however, little specific information available on any existing impacts on water resources from previous mining activities or other stressors. To definitively address the possibility of adverse cumulative effects, a detailed water resources survey and an assessment of the effects of any proposed mine on these resources must be undertaken as part of a site-specific environmental assessment.

5.5 Socio-economic Assessment

5.5.1 Land Use

Land use is a valued environmental component because of its fundamental importance to community development and well being. Land use includes all existing industrial, commercial and residential development, as well as settlement areas, lands used for recreation, and other areas of special community or social value. It is important to consider the compatibility of potential projects with existing land uses, local land use plans and zoning designations to assess if cumulative effects on land use are expected.

General Overview and Development Concerns

The four blocks can be largely characterized as rural with some farming, human settlements and industrial development in the Point Aconi block. One of the issues raised by residents living nearby to an industrial development is its effect on property values. Past surface mining study (McKown 1995) of sand and gravel quarries in the United States has shown that property values can be affected by surface mining operations due to visual and aesthetic effects. Local residents have also raised concerns in public meetings that their property values may be affected through impacts to the water supply from mining projects. Surface coal mining is not identified as one of the planned land uses by the CBRM (B. Spicer, pers., comm., 2005)

5.5.1.1 Overview of Existing Conditions

Point Aconi Block

This claim block includes Prince Mine where there is currently an inactive underground coal mining operation. Nova Scotia Power's coal fired power generating station is also located north of the block. There are numerous buildings in this block including the community of McCreadyville (Figure 1.2A). The human settlement is largely located along local roads. Numerous coal shafts, most likely associated with past bootleg mining, are also found in this block (Figure 1.3A).

An expansion of the existing mine in the Point Aconi block as proposed by Pioneer Coal can be expected to come in conflict with surrounding uses of the land. There are residential structures nearby, east of the current mine site and Pioneer is proposing to negotiate purchase of some these homes because the coal seam to be mined extends underneath these homes.

Although there is no tourism infrastructure in this block, visitors do make their way to the Point Aconi lighthouse to the north of the block. Ciboux Island and Hertford Islands, also known as Bird Islands, are an eco-tourism attraction of some renown and are located approximately eight kilometres away.

Boularderie Island Block

There are numerous buildings and communities in the block including Mill Pond and Black Rock (Figure 1.2A). These buildings and communities are mostly located along local roads with relatively heavy concentration along the Little Bras d'Or Channel. One of the most important land uses in the area is over 500 acres of agricultural land, located in the central portion of the block (NSDNR 2003). A local agricultural producers cooperative in this section of Boularderie reports farm gate sales of over $7 million annually and employment of over 250.

Although there is no significant tourism infrastructure in the block, local outfitting and nature based recreation and tourism may occur (S. MacDonald, pers., comm. 2005). Numerous coal shafts, most likely associated with past bootleg mining, are also found in this block (Figure 1.3A). A surface coal mining exploration license has been approved in the southeast corner of the block, north of Mill Creek (NSDNR 2005).

The main concerns with respect to land use issues include potential conflicts with agricultural and recreational use of the land. Local residents have also expressed concerns about impact on groundwater supply and dust from surface mine developments.

Birch Grove Block

The communities located in the Birch Grove claim block include Birch Grove, Morien Junction and Morien (Figure 1.2B). A sewage treatment facility is located in the middle of the claim block. Numerous coal shafts, most likely associated with past bootleg mining, are also found in this block (Figure 1.3B) There are several abandoned railway lines in the block which are used by local all terrain vehicle recreation groups (L. House, pers. comm., 2005). Birch Grove borders some of CBRM's public water supply watershed areas of John Allen Lake, MacAskills Brook Reservoir and Sand Lake (Figure 1.2B). Morien Bay, an area identified by local residents as important lobster grounds, borders the block to the east. Port Morien, located along Morien Bay has implemented various measures to attract tourism (S. MacDonald, pers., comm., 2005). There are also local outfitting and nature based recreation land uses in the area.

Birch Grove block contains several communities which could be affected by future surface coal developments. In particular, there are concentrations of residences in proximity to the coal seams as well as surface water supply areas. There are recreational land uses both within the block and in the vicinity. Local residents have raised concern about the effects of mine water drainage into commercially active Morien Bay located east of the block.

Broughton Block

The two communities located in this block include Morrison Road and Broughton. This block is largely wooded with little or no industrial activity (B. Spicer, pers. comm., 2005). Numerous coal shafts, most likely associated with past bootleg mining, are also found in this block (Figure 1.3B). There are some abandoned railway beds which are used by local all terrain vehicle recreation groups (L. House, pers. comm., 2005)

The two communities in the Broughton block, Morrison Road and Broughton, may constrain any future coal development. There would also be a potential for land use conflict with recreation use of the abandoned railway in some parts of the block.

5.5.1.2 Effects Assessment and Mitigation

Surface coal mining can affect local land use. These effects can be broadly classified as short and long term effects. In the short term, adverse effects are expected if surface coal mining excludes other land uses in the area. Furthermore, there can be adverse effect on property values due to impacts on visual aesthetics and other nuisance effects (*e.g.*, noise, dust). Some of these adverse effects such as reduced property value may be mitigated through practices such as vegetative buffer and landscaping. Refer to Section 4 for detailed mitigation and best management practices to address these issues including site reclamation. Other short term adverse effects such as exclusion of other land uses, for example, recreation and farming, may not be mitigated until sites are fully reclaimed. NSDNR believes that there may be long term positive effects on land use provided that proper reclamation is carried out. For example, areas within these blocks are characterized by past bootleg mining operations which have resulted in restricted land use. Reclamation of these sites could allow for alternative uses of these previously mined areas. Proper reclamation could also allow long term land use that is consistent with past use such as recreation, farming, in the area. However, many local residents dispute this assessment as they believe that old mine workings many either not require reclamation or should be reclaimed by means other than near surface mining.

As indicated in section 2, letters have been sent to the five First Nations in Cape Breton and to other Mi'kmaq organizations, requesting comments on issues relating to the cumulative effects study. More time has been requested to prepare a response. Once received, this information will be forwarded to NSEL.

5.5.1.3 Cumulative Effects Summary

The potential cumulative effect on land use of most concern would be the potential for adding new sites that are disturbed in an area which already has a significant inventory of similarly impacted sites as a result of past mining activities. The extent of the impact will depend on: the quality of the site reclamation; the resulting potential of the land to support alternate land uses; the resources available to develop those land uses; and the local need and demand for such uses. In the context of Boularderie Island, new surface mines will be added to a concentration of existing older mine sites. The Birch Grove and Broughton blocks have largely been impacted by extensive underground workings and associated facilities.

NSDNR has indicated that surface coal mining has the potential to have a positive effect on land use through proper reclamation of past mine workings. However, a project specific assessment that looks at the trade-offs between the removal of old mine workings and the loss of aesthetics and ecological values through surface coal mining is needed for more definitive cumulative assessment.

In summary, mitigative measures and best management practices are available to potentially reduce adverse cumulative effects on land uses to non-significant levels. However, given the concentration of previously impacted lands in some areas within the four resource blocks, with some in close proximity to residential development and areas proposed for future mining (*e.g.*, Birch Grove), significant cumulative effects on land use are possible. Some effects on land use (*e.g.*, land value, enjoyment of lands) are somewhat subjective and difficult to quantify. It is clear that CBRM is not in favor of surface coal mining as a desirable land use. A more precise evaluation of the significance of potential cumulative effects on land use can only be undertaken in the context of a project specific EA.

5.5.2 Transportation Infrastructure

Transportation is a valued environmental component due to potential effects of project related traffic on existing patterns of transportation infrastructure. Potential increases in heavy truck and equipment traffic may interact with past and existing use to impact transportation network through wear and tear and road safety. While there is discussion about possible use of the Cape Breton rail line to transport coal from surface coal mining operations to end users, all transportation from the mine sites would be by road.

5.5.2.1 Overview of Existing Conditions

Point Aconi Block

The Point Aconi block is accessible through two major roads: Highway 162, originally developed to service the Point Aconi Power Plant, and Point Aconi Road (Figure 1.2A). Highway 162 traverses the south west corner of the block and connects with Highway 105, the TransCanada Highway, approximately 7 km to the south. Point Aconi Road traverses the block in the east and connects with the TransCanada Highway approximately 6 km to the south. In addition to these roads, there are numerous other minor roads that traverse the landscape. A majority of these minor roads are associated with human settlement and structures. The Prince Mine is connected to Highway 162.

Boularderie Island Block

The Boularderie Island block is accessible through two major roads: Highway 162 and Point Aconi Road (Figure 1.2A). Both of these roads traverse the block to the east and connect with Highway 105, the TransCanada Highway, approximately 3 km to the south. Other local roads in the block connect with the Millville Highway which connects to the TransCanada Highway. In addition to these roads, there are numerous other minor roads that traverse the landscape. A majority of these minor roads are associated with human settlement and structures associated with local land use.

Birch Grove Block

The Birch Grove block is accessible through three major roads: Highway 225, Birch Grove Road and Broughton Road (Figure 1.2B). Highway 225 traverses the block to the east and is associated with numerous human structures and buildings. This highway connects the block to the communities of Port Morien, Donkin and Glace Bay to the north. Broughton Road traverses in the east west direction in the north and connects to Highway 225 in the east and Highway 22 approximately 16 km to the south east. Birch Grove Road connects north to Highway 225. In addition to these roads, there are numerous other minor roads that traverse the landscape. A majority of these minor roads are associated with human settlement and structures associated with local land use. This block also includes several CBDC rail way lines.

Broughton Block

The Broughton block is accessible by two major roads: Broughton Road and Morrison Road (Figure 1.2B). These roads connect to the two major roads in the area, Highway 225 located approximately 10 km to the east and Highway 22 located approximately 10 km to the west. This block also includes several abandoned CBDC rail way lines.

Development Concerns

The main transportation issues with respect with surface coal mining include wear and tear on the transportation infrastructure from coal trucks, adequacy of existing road network to handle heavy truck traffic, road safety, and coal dust during transport. CBRM is concerned about the impact on existing road infrastructure and does not have the resources to provide upgraded or new transportation infrastructure to potential surface coal mine sites (B. Spicer, pers., comm., 2005). Road safety issues may be lessened in areas where future mine developments are easily accessible by major roads. Another area of concern is the Spring Weight Restrictions which limits the load carried on roads during the spring. While the highways generally do not have Spring Weight Restrictions, local roads and routes generally have restrictions (G. Lee, pers., comm. 2005).

5.5.2.2 Effects Assessment and Mitigation

Surface coal mining can affect the transportation network. These effects can be broadly classified as short and long term effects. In the short term, adverse effects are expected since traffic associated with coal developments are likely to place increased demand on local roads and associated infrastructure. Based on Pioneer Coal's and Thomas Brogan and Sons' environmental registrations approximately 50 trucks (35 tonne tractor trailers) are expected from the Point Aconi block and surrounding area. Other operations similar in scope to Pioneer Coal can be expected to generate similar truck traffic volume. Furthermore, the presence of large coal trucks may also pose safety hazard to existing traffic. However, a traffic volume report and road assessment is required to determine if significant cumulative effect is expected. Some mitigation measures include coal transport when existing traffic volume is low, minimizing trip frequency and using dust suppression methods. Section 4 provides further details on mitigation and best management practices to minimize the effects on transportation network. The wear and tear on the transportation infrastructure cannot be mitigated except through road repairs and improvements and may represent a long term adverse effect.

5.5.2.3 Summary of Cumulative Effects

Depending on the roadways used, there may be cumulative effects on the transportation network. For example, proposed surface coal developments in the Point Aconi and Boularderie Island blocks would use Highway 162 to transport coal from the mine sites. Addition of approximately 50 trucks daily from Point Aconi and nearby mine developments will result in cumulative effects on Highway 162 in conjunction with existing traffic and impacts to infrastructure. Potential future mine developments in Broughton and Birch Grove blocks would likely use the two major roads in the area, Highways 225 and 22 to access regional centres of Glace Bay and Sydney. Addition of this traffic from these mine developments will result in cumulative effect on the transportation network in Highways 225 and 22. However, a traffic volume report and road assessment is required to determine if significant cumulative effect is expected. Potential benefits of creation of new roads associated with surface mining must be balanced by the cost of maintaining these roads for future use. In some cases the existing traffic volume may not warrant these additional roads.

There has been a suggestion that expanded surface coal mining in CBRM could significantly improve the ongoing viability of the Cape Breton and Central Nova Scotia Railway, enabling it to stay in operation until the coal from the proposed Donkin mine re-opening can be shipped on this railway. However, an assessment of the cumulative effect of surface coal mining on the future of the rail line is beyond the scope of this study. Mitigative measures and best management practices are available to potentially reduce cumulative effects to non-significant levels. However, significant adverse cumulative effects on the transportation infrastructure are possible. A definitive assessment of significance of cumulative effects on transportation infrastructure can only be made in the context of a project specific assessment.

5.5.3 Human Health and Public Safety

Human health and public safety is a valued environment component because of its importance to community well being. Public safety can be adversely affected by open pits, abandoned mines and related workings. This is particularly true in areas that have already been disturbed by past mining activities. Human health issues related to construction and operation of surface coal mining operations are discussed under Air Quality (5.4.1) and water resources (Section 5.4.3) in the context of guidelines and mitigative measures that have been developed in consideration of protection of human health.

5.5.3.1 Overview of Existing Conditions

Since public safety issues associated with abandoned mine openings are likely to be similar in the four blocks, description of the existing environment for all four blocks are presented together. The four blocks, particularly Point Aconi and Boularderie Island blocks, contain numerous coal shafts from historical mining activities some of which are located close to communities and residences (Figure 1.3A, 1.3B). Some of these historically mined areas contain hazardous mine opening or other unstable features making these areas structurally unstable and hazardous to public safety (NSDNR 2003). These previously mined areas have not been adequately reclaimed and NSDNR believes there is a need to reclaim these lands (NSDNR 2005). However there is no public consensus on this matter yet.

Surface coal mining operations, like other industrial developments, can have adverse effect on public safety. These include presence of large industrial machinery and equipment and hazards created by disturbed landscapes. There may also be some concerns if mining operations do not reclaim previously mined areas and contribute to the hazard through poor reclamation.

5.5.3.2 Effect Assessment and Mitigation

Surface coal mining can affect public safety. These effects can be broadly classified as short and long term effects. In the short term, during mine operation, adverse effects are possible. However, these adverse effects may be mitigated through standard practices such as proper signage and perimeter fencing. Section 4 provides further details on mitigation and best management practice to ensure that there are no significant adverse effects on public safety. A positive effect will likely result from the reclamation of previously disturbed sites (*i.e.*, through reclamation mining) such that these sites are structurally stable and contain no hazardous openings. This positive effect is dependent on proper reclamation of mined areas.

5.5.3.3 Cumulative Effects Summary

No significant adverse cumulative effects on public health and safety are expected if standard mitigation is applied and if proper reclamation following surface mining operations is conducted. This reclamation will likely address public safety issue (*i.e.*, a positive effect) associated with existing hazardous mine openings and structurally unstable lands. This could result in a positive cumulative effect in conjunction with other regional mine reclamation activities. Adverse cumulative public safety issue is possible if there is inadequate reclamation of potential future surface coal mining operations when combined with existing hazards from previously mined areas. A more definitive assessment of significance of cumulative effects on human health and public safety can only be made in the context of a project specific assessment.

5.5.4 Labour and Economy

Labour and economy is a valued environmental component because it is indicative of one aspect of the socio-economic well being of a community. Labour and economy is evaluated with respect to regional and local employment and business. The focus is on employment, business opportunities and changes to the local economy.

5.5.4.1 Overview of Existing Conditions

Since socio-economic characteristics specific to the mineral claims areas were not available, selected socio-economic characteristics for the whole CBRM are presented. The information presented below is based on the results of 2001 census conducted by Statistics Canada (2001). The CBRM has a population of 109,330 and covers an approximate area of 2,500 square kilometres (Statistics Canada 2001).

The population of CBRM registered a decline of approximately 8% between 1996 and 2001. The median age of the population was 41.3 years with 83% of the population being over the age of 15 years. The median household income was $ 32,623 compared to $ 39,908 for Nova Scotia. The unemployment rate was 19.4% which is substantially higher than the overall Nova Scotia rate of 10.9%. There were a total of 35,825 persons employed in CBRM. Some leading sources of employment include service (45%), retail (18%) and government (8%). Other employment sources include manufacturing, construction, transportation and natural resources extraction. Recent years have also seen significant growth in tourism and tourism related activities. For example, the port of Sydney hosts increasing numbers of cruise ships yearly. Tourism has been identified as one of the economic development strategy for the CBRM (J. Whally, pers. comm., July 2005).

Surface coal mining and economic development of CBRM's tourism are not viewed as being compatible (B. Meloney; S. MacDonald; J. Whally pers., comm., July 2005). Furthermore, there are limited opportunities for further economic development in the CBRM associated with surface coal mining (J. Whally pers., comm., 2005). Although no specific tourism infrastructures are located in the blocks, tourists may encounter coal mining areas or infrastructures such as coal trucks along travel routes. These encounters have the potential to give negative image of Cape Breton to these tourists (S. MacDonald, pers., comm., July 2005). Local community members have also raised concerns that coal mining areas in Boularderie Island block may be visible from some vantage points along the TransCanada Highway and thus negatively affect tourism in the area. Local communities have also identified the potential negative impacts to local fishery resources.

5.5.4.2 Effects Assessment and Mitigation

Surface coal mining can have positive and negative effects on labour and economy. From a regional perspective, positive effects include access to employment, particularly through spin-off jobs and purchasing (B. Meloney, pers., comm., 2005). Direct and indirect employment benefits can be expected from surface coal mining operation. For example, based on NSDNR assumptions, the combined direct and indirect employment effects of the two projects currently registered in the Point Aconi area are expected to be approximately 100 jobs. Nova Scotia also receives royalties of dollar per tonne of coal mined. Based on the estimated coal on four resource blocks the total royalties can be estimated to be approximately 9 million dollars (NSDNR 2005; NSDNR 2003a). In addition to royalties, coal mining operations also provide tax revenues to local and provincial governments.

However, from a local community perspective there could be no effect particularly if such spin-off jobs and local purchasing occur in the larger regional urban centres. A standard mitigation is to institute local purchasing and hiring programs, but the efficacy of such programs may be constrained by the capacity of a local community to provide the required services.

An additional benefit of reclamation mining includes the avoided costs of government sponsored reclamation. Reclamation mining allows the extraction of a resource and can address land use issues associated with past mining activities (*e.g.,* remove safety hazards from bootleg pits). The NSDNR estimate of government sponsored reclamation is potentially in the hundreds of millions of dollars.

However, these fiscal and employment benefits need to be balanced with the costs of surface mining. These costs can include the direct costs associated with mining in addition to potential adverse effects on local industries of an area (*e.g.,* recreational use). Unlike the benefits, some of these costs may not readily be quantifiable but nonetheless can be important to the local economy.

There are mitigation measures that can be used to reduce the potential adverse effects. For example, the negative effect on tourism may be mitigated through use of visual screening and landscaping and will likely be site specific. The effect on local fishery resources is dependent on ground and surface water management at a mine site. Provided that no harmful substances are discharged into fishery areas no adverse effect can be expected.

5.5.4.3 Cumulative Effects Summary

Overall, a positive effect on the labor and economy can be expected. It should be noted however, that overall positive effect can potentially mask local effects which may or may not be positive. As such, mitigation measures that are responsive and specific to area affected should be adopted. Provided that proper mitigation and management practices are carried out no significant cumulative adverse effects are expected.

5.6 Summary of Cumulative Effects

A generalized cumulative effects assessment has been undertaken for potential surface coal mining projects in CBRM focusing on four resource blocks issued for tender in December 2003. Limitations of the study have been described in Section 1.4. The assessment, described in the previous sections of this report, was organized by VECs and included: a brief description of existing environmental and socio-economic conditions; development concerns; effects assessment and mitigation; and summary of residual cumulative effects. Additional mitigation and best management practices Assessment boundaries and significance criteria were also applied for each VEC. Typical mining activities and potential environmental interactions were identified and potential likely surface coal mining scenarios developed for the assessment. Mitigation measures and best management practices were also identified. A summary of the assessment undertaken and recommendations for additional study is presented in Table 5.6 below.

The cumulative effects assessment concluded that surface coal mining will create a number of adverse effects on valued environmental and socio-economic components, and that these effects will potentially interact with other past, present and future projects and activities to create cumulative effects on those components. However, on a project by project basis these effects may not be significant, or could potentially be mitigated to non-significant levels.

TABLE 5.6 Summary of Residual Cumulative Environmental Effects and Follow-up

VEC/VSC	Mitigation	Residual Cumulative Environmental Effects	Follow-up
Atmospheric Environment	▪ Dust control; ▪ Noise abatement; ▪ Implement mitigation presented in Section 5.4.1; and ▪ Implement select BMPs presented in Section 4.0.	▪ Potential for cumulative adverse environmental effects on atmospheric environment. ▪ Impacts are likely limited due to localized (typically < 1km) effects (noise and dust) and anticipated effectiveness of mitigation.	▪ Project specific EAs should evaluate the effects of the proposed activities on the atmospheric environment (noise and dust) in consideration of local sensitive receptors. ▪ EA should include assessment of other potential sources of noise and air emissions in the vicinity of the project to ensure cumulative impacts are managed to non-significant levels.
Terrestrial Environment	▪ Avoid sensitive habitat (*e.g.*, wetlands) and species; ▪ Compensate wetland loss; ▪ Effective site reclamation including revegetation and habitat redevelopment; ▪ Implement mitigation presented in Section 5.4.2; ▪ Implement select BMPs presented in Section 4.0.	▪ Potential for cumulative adverse environmental effects on terrestrial environment. ▪ Impacts depend on the presence of sensitive habitats (*e.g.*, wetlands) or species within the project areas and whether avoidance or other appropriate mitigation is pratical. ▪ Reclamation mining may result in improvements to habitat with proper site restoration.	▪ Project specific EAs should identify sensitive habitats and species within the project area and existing impacts. This should include site specific field surveys. ▪ Impacts on sensitive habitats and species should be characterized on a local and regional and/or provincial level to ensure that cumulative impacts are managed to non-significant levels
Fish and Fish Habitat	▪ Avoid direct impacts on watercourses and buffer zones (*i.e.*, 30 m buffer); ▪ Implement appropriate erosion and sediment control measures; ▪ Control/treat acid drainage; ▪ Compensate for habitat lost; ▪ Implement mitigation presented in Section 5.4.3; ▪ Implement select BMPs presented in Section 4.0.	▪ Potential for cumulative adverse environmental effects on fish and fish habitat. ▪ Impacts will tend to be limited within affected watersheds and will depend on pre-existing impacts to water quality and aquatic habitat from other projects (*e.g.*, mining, forestry and agriculture). ▪ Reclamation mining may result in overall positive effects on fish and fish habitat if existing contaminants sources (*e.g.*, ARD) are removed.	▪ Project specific EAs should characterize fish and fish habitat including assessment of water quality, hydrology, and fish surveys. ▪ Assessment should include consideration of effects from previous, existing and likely future projects on fish and fish habitat in the area and within the local watershed.

TABLE 5.6 Summary of Residual Cumulative Environmental Effects and Follow-up

VEC/VSC	Mitigation	Residual Cumulative Environmental Effects	Follow-up
Water Resources	▪ Minimize dewatering; ▪ Minimize/avoid ARD production; ▪ Pre-blast well surveys; ▪ Replace impacted water supplies; ▪ Groundwater monitoring; ▪ Erosion and sediment controls; ▪ Implement mitigation presented in Section 5.4.4; ▪ Implement select BMPs presented in Section 4.0.	▪ Potential for cumulative adverse environmental effects on water resources (surface and groundwater supplies). ▪ Effects on groundwater resources from blasting or dewatering typically localized (*e.g.*, < 1km).	▪ Project specific EAs should evaluate the effects of the proposed activities on the water resources in consideration of existing local users and potential future water resource development. ▪ EA should include assessment of other potential stressors on water resources in the vicinity of the project to ensure cumulative impacts are managed to non-significant levels.
Land Use	▪ Minimize visual impacts; ▪ Minimize noise and dust; ▪ Transportation planning; ▪ Plan activities (*e.g.* blasting) to avoid sensitive times of day. ▪ Community involvement in reclamation planning; ▪ Implement mitigation presented in Section 5.5.1; ▪ Implement select BMPs presented in Section 4.0.	▪ Potential cumulative adverse environmental effects on land use. ▪ Effects depend on proximity of receptors and type of existing land uses and extent to which land has been previously impacted. ▪ Effects depends on effectiveness of mitigation of nuisance impacts (*e.g.*, noise, dust, and visual); ▪ Reclamation mining may result in an overall positive effect on land use depending on previous impacts at the site and effectiveness of reclamation planning and implementation.	▪ Project specific EAs should evaluate impacts of the project on land use particularly in consideration of existing land uses as well as planed uses. ▪ EA should address community concerns and involve potentially affected landowner in project planning.
Transportation Infrastructure	▪ Follow posted speed limits; ▪ Modify trucking to avoid peak hours; ▪ Implement mitigation presented in Section 5.5.2; ▪ Implement select BMPs presented in Section 4.0.	▪ Potential cumulative adverse environmental effects. ▪ Effects depend on existing traffic volumes, trucking routes and road conditions.	▪ Project specific EAs should consider impacts on transportation infrastructure in consideration of proposed trucking routes, existing road conditions and traffic generated by existing and potential future developments.

TABLE 5.6 Summary of Residual Cumulative Environmental Effects and Follow-up

VEC/VSC	Mitigation	Residual Cumulative Environmental Effects	Follow-up
Human Health and Public Safety	▪ Ensure active mine areas are clearly marked and secured; ▪ Implement mitigation presented in Section 5.5.3.	▪ Potential for cumulative environmental effects is limited due to the relative short duration and localized nature of the effects. ▪ Reclamation mining may result in an overall positive effect on human health and public safety (*i.e.*, removal of existing hazards).	▪ Project specific EAs should evaluate potential effects on human health and public safety.
Labour and Economy	▪ Maximize local buying and hiring; ▪ Mitigation to reduce nuisance impacts (*e.g.*, noise, dust, and visual) which could affect other industries and/or public perception; ▪ Implement mitigation presented in Section 5.5.4.	▪ Potential cumulative environmental effects depending on proximity of other industries, public perception and effectiveness of nuisance mitigation. ▪ Surface coal mine development can result in overall positive effects on labour and economy from employment and business opportunities and royalties and taxes to governments.	▪ Project specific EAs should evaluate impacts of the development on existing industries (*e.g*, tourism) and should calculate economic benefits (including benefits from reclamation of previously impacted sites).

For the biophysical VECs, cumulative adverse effects are likely on: atmospheric environment (methane release); water supply (reduction in groundwater supply quality or quantity); terrestrial environment (habitat loss and fragmentation); and fish and fish habitat (habitat loss or degradation). A number of potential environmental effects from individual surface coal mining projects are expected to be relatively limited in spatial extent (*e.g.*, dust, noise, impacts to wells) which would tend to limit cumulative effects to within a relatively short distance from the mines (*e.g.*, 1 km) and would limit cumulative effects between the developments. Standard mitigative measures (*e.g.*, dust suppression, water discharge controls), if carefully applied and strictly enforced, would likely be effective in reducing offsite impacts from many mining activities and thus the potential for cumulative effects. Application of best management practices would further limit the potential for offsite impacts and cumulative effects. In particular, effective mitigation would include avoidance of sensitive habitats (*e.g.*, wetlands and watercourses), occurrences of rare species, and areas of high water resource use as a priority during mine planning. Where sensitive areas cannot be avoided, compensation is often considered an acceptable, though not preferred, form of mitigation (*e.g.*, wetland and fish habitat compensation, well replacement).

Proper reclamation of surface coal mining sites using best management practices is considered essential to the overall acceptability of the industry and reduction of long-term cumulative environmental effects (*e.g.*, habitat replacement). It is anticipated that some positive cumulative ecosystem effects could occur if reclamation mining restores habitat and/or reduces harmful discharges at sites that are currently degraded from previous industrial activities.

The socio-economic environment encompasses a range of social and economic factors that need to be considered when undertaking a project due to its importance for economic development, health and well being and quality of life of a community. There will likely be cumulative adverse effect on land use if all four resource blocks were to be developed over the next few years in conjunction with previously impacted lands in the area. These adverse effects include impact to visual aesthetics, amenity services (*e.g.*, recreation), and an alteration of the perceived characteristics of the affected areas. Some effects would be of limited duration, spanning the life of a project and some effects are amenable to mitigation and best management practices. Significant adverse cumulative effects are possible however, particularly if coal mining contributes to a negative image of Cape Breton and local communities. There is potential for a positive effect on public safety if surface coal mining operations successfully remove hazardous openings and past mining undertakings. Additional benefit can also include avoided cost of government sponsored reclamation. However, the extent of this positive effect, especially weighed against alternative approaches and other effects of surface coal mining requires further study.

Provided that proper mitigation there are likely little cumulative effects on labour and economy as they tend to be restricted to the duration of a specific project.

In summary, mitigative measures and best management practices are available to potentially reduce cumulative impacts from surface coal development to non-significant levels for the valued environmental and socioeconomic components assessed (assuming strict compliance and monitoring). However, there remains the potential for significant adverse effects to occur based on the specific characteristics of each project site and according to each project design. A definitive assessment of the significance of residual cumulative effects can only occur in the context of project specific environmental assessment. Project specific assessment must also be supported by a thorough monitoring program and strict enforcement of environmental protection measures by both the proponent and government inspection.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study examines issues related to potential cumulative environmental and socio-economic effects of proposed surface coal mining in CBRM with a focus on four recently tendered coal resource blocks. The main components of the study include:

- a public and stakeholder consultation program;
- identification of mitigative measures and best management practices for environmental protection; and
- a generalized cumulative effects assessment.

Public and stakeholder consultation was carried out within CBRM to identify issues of concern. Concerns identified include:

- Industry competence with regard to environmental management;
- Government's willingness to consult the public;
- Government's capacity to monitor and regulate the surface coal mining industry;
- The effectiveness of best management practices to avoid environmental impacts and achieve high standards of site reclamation; and
- The concept of reclamation mining as a beneficial way to remove public hazards.

Mitigative measures and best management practices were identified from Nova Scotia, other Canadian jurisdictions and the United States. These practices covered a wide range of potential environmental and socio-economic issues related to surface coal mining including management of air and water emissions and site reclamation.

The cumulative effects assessment concluded that surface coal mining will create a number of adverse effects on valued environmental and socio-economic components, and that these effects will potentially interact with other past, present and future projects and activities to create cumulative effects on those components. However, on a project by project basis these effects may not be significant, or could potentially be mitigated to non-significant levels.

Cumulative adverse effects are likely on: atmospheric environment; water supply; terrestrial environment; and fish and fish habitat. A number of potential environmental effects from surface coal mining are expected to be relatively limited in spatial extent which would tend to localize cumulative effects. Standard mitigative measures, if carefully applied and strictly enforced, would likely be effective in reducing offsite impacts from a number of mining activities and thus the potential for cumulative effects. Application of best management practices would further limit the potential for offsite impacts and cumulative effects. In particular, effective mitigation would include avoidance of sensitive habitats, occurrences of rare species, and areas of high water resource use as a priority during mine planning.

Proper reclamation of surface coal mining sites using best management practices is considered essential to the overall acceptability of the industry and reduction of long-term cumulative environmental effects. It is anticipated that some positive cumulative ecosystem effects could occur if reclamation mining restores habitat and/or reduces harmful discharges at sites that are currently degraded from previous industrial activities.

There will likely be cumulative adverse effects on land use if all four resource blocks were to be developed over the next few years in conjunction with previously impacted lands in the area. These adverse effects include impacts to visual aesthetics, amenity services (*e.g.*, recreation), and an alteration of the perceived characteristics of the affected areas. Some effects would be of limited duration, spanning the life of a project and some effects are amenable to mitigation and best management practices. Significant adverse cumulative effects are possible however, particularly if coal mining contributes to a negative image of Cape Breton and local communities. There is potential for a positive effect on public safety if surface coal mining operations successfully remove hazardous openings and past mining undertakings. The extent of this positive effect, especially weighed against alternative approaches and other effects of surface coal mining requires further study. There will be some positive cumulative effects on labour and economy as well as avoided reclamation costs for government.

In summary, mitigative measures and best management practices are available to potentially reduce cumulative impacts from surface coal development to non-significant levels for the valued environmental and socio-economic components assessed (assuming strict compliance and monitoring). However, there remains the potential for significant adverse effects to occur based on the specific characteristics of each project site and according to each project design. A definitive assessment of the significance of residual cumulative effects can only occur in the context of project specific environmental assessment. Project specific assessment must also be supported by a thorough monitoring program and strict enforcement of environmental protection measures by proponents and government.

6.2 Recommendations

The following recommendations are provided for NSEL with respect to its decision making process for surface coal mining proposals in CBRM and are generally limited to areas within the NSEL mandate. The recommendations should be considered as tools to address potential cumulative effects identified through the preceding analysis. In addition to the specific recommendations for use in decision making, some policy level recommendations are also provided for future considerations.

Issue: Adoption of Best Management Practices

- NSEL should review potentially applicable best management practices (in addition to standard environmental management practices) within the context of the project-specific environmental assessment process and incorporate them as a condition of project approval.

Issue: Reclamation planning

- NSEL (in consultation with NSDNR) should develop a surface mine reclamation planning program including: standards for surface mine reclamation; appropriate research for reclamation and revegetation techniques; an evaluation/monitoring program for reclamation success; and opportunities for community involvement. Progressive reclamation should be required as part of reclamation planning.

Issue: Community consultation and involvement

- Proponents should be required to engage the community members during the preparation of environmental registration documents as well as during project activity and reclamation. Some specific measures include holding public meetings and formation of community liaison committees. NSEL should develop specific guidance for community involvement for surface coal mining proposals.

Issue: Cumulative effects

- Given the potential for individual surface mine projects to result in cumulative environmental effects in combination with past, present, and potential future undertakings, NSEL should require environmental assessments of CBRM surface coal mines to include an evaluation of potential cumulative environmental effects. This should include consideration of valued ecosystem components identified through this study. To provide direction to proponents, NSEL should develop a guideline for cumulative effects assessment as a component of project specific assessment under the Environmental Assessment Regulations.

7.0 REFERENCES

7.1 Literature Cited

ADI Limited, JWEL and S. Forgeron (2002). Mine Water Assessment and Monitoring Program. Cape Breton Development Corporation. No. 1B Hydraulic System. Preliminary Draft October 30. 2002.

Baechler, F.E. (1986). Regional Water Resources, Sydney Coal Field. Nova Scotia Department of the Environment, Halifax, N.S. 1986. 111 p.

Baker, J. P., and C.L. Schofield. 1982. Aluminum toxicity to fish in acidic waters. Water, Air, and Soil Pollution 18:289-309.

Beanlands, G.E. and P.N. Duinker. 1983. An Ecological Framework for Environmental Impact Assessment in Canada. Institute for Resource and Environmental Studies, Dalhousie University, in cooperation with the Federal Environmental Assessment Review Office. 132 pp.

Brown, D.J.A. and K. Sadler, 1989. Fish survival in acid waters. In: Acid Toxicity and Aquatic Animals. Society for Experimental Biology Seminar Series: 34, (Morris, R. et al., eds.), Cambridge University Press, pp. 31-44.

Cape Breton Coal. 2004. In depth: Cape Breton Coal. CBC News Online. Available: http://www.cbc.ca/news/background/capebreton

CBRM. 2004. Municipal Planning Strategy. Cape Breton Regional Municipality.

CEA Agency. 1999a. Cumulative Effects Assessment Practitioners Guide. Prepared by Canadian Environmental Assessment Working Group and AXYS Environmental Consulting Ltd.

CEA Agency. 1999b. Addressing Cumulative Environmental Effects Under the *Canadian Environmental Assessment Act*. Operational Policy Statement OPS-EPO/3-1999.

CEA Agency. 1994. Responsible Authority's Guide. Hull, QB.

Citizens Against Strip Mining (CASM). 2005. Background on Effects of Surface Coal Mines in CBRM. Complied bt Hugh Kennedy.

Cooper, E.L. and C.C. Wagner, 1973. The effects of acid mine drainage on fish populations. In: Fish and Food Organisms in Acid Mine Waters of Pennsylvania, Environmental Protection Agency Report No. EPA-R3-73-032, p. 114.

Frost, L. (1964). A Reiew of the Coal Properties Operated by Dominion Steel and Coal Corporation Ltd. Louis Frost, Chief Mining Engineer, March 1964.

Giles, P.S. 1983. Sydney Basin Project: Mines and Minerals Branch Report of Activities, 1982. NS Dept. of Mines and Energy Report 83-1. pp. 57-70.

Grant, D. R. 1989. Quaternary Geology of The Atlantic Appalachian Region Of Canada : Geological Survey of Canada.

Haines, T.A., 1981. Acidic precipitation and its consequences for aquatic ecosystems: A review. Trans. Am. Entomol. Soc., v. 110, pp. 669-707.

Health Canada. 2004. Guidelines for Canadian Drinking Water Quality, Internet Ed. Prepared by Federal-Provincial Subcommittee on Drinking Water of the Federal-Provincial Committee on Environmental and Occupational Health. Canada Communications Group Pub., Ottawa, ON. Internet Publication: http://www.hc-sc.gc.ca/hecs-sesc/water/dwgsup.htm. Last updated June 2005.

Hem, J. D., 1970. Study and Interpretation of the Chemical Characteristics of Natural Waters, 2nd. edition. United States Geological Survey Water Supply Paper No. 2254, 363 p.

Hoehn, R.C. and D.R. Sizemore, 1977. Acid mine drainage (AMD) and its impact on a small Virginia stream. Water Res. Bull. v. 13, pp. 153-160.

Jacques Whitford and Associates Limited (JWA). 1993. Colliery Water Study, Sydney Coal Fields, Cape Breton , Nova Scotia. Report to Cape Breton development Corporation. Project No. 8728, September 16, 1993.

Jacques Whitford Environment Limited (JWEL). 1997. Environmental Engineering Study - Update Status of Flooding Mines. Report to Cape Breton development Corporation. Project No. 11545, February 25, 1997.

Jacques Whitford Environment Limited 1993. Environmental Isotope Sampling at the Lingan-Phalen Mine. JWEL Report No. 8496 to Cape Breton Development Corporation, Feb. 26, 1993.

Jacques Whitford Environment Limited. 1990. Long Term Groundwater Development Assessment, Point Aconi, Cape Breton Island. JWEL Report No. 5359 to Nova Scotia Power Corp., June 13, 1990.

Jacques Whitford Environment Limited. 1988-1991. Series of letter reports to CBDC respecting Hydrochemical and Environmental Isotopic Monitoring at the Lingan and Phalen Mines, Cape Breton, N.S. JWEL Project No. H1115.

Jacques Whitford Environment Limited (1992). Investigation of Earth Energy Potential From Abandoned Coal Mines - Westville, NS. Report to Pictou County Development Fund (PICORD). JWEL Report No. NSD8461.

Keppie, J. D. 2000. Geological Map of the Province of Nova Scotia. N.S. Department of Natural Resources. Minerals and Energy Branch. Map ME2000-1. Scale 1: 500,000.

Kevin Stone, NR Can. Pers. Comm.. July 2005.

Kimmel, W.G., 1983. The impact of acid mine drainage on the stream ecosystem. In: Pennsylvania Coal: Resources, Technology and Utilization, (S. K. Majumdar and W. W. Miller, eds.), The Pa. Acad. Sci. Publ., pp. 424-437.

King, John. 2000. Greenhills Development Surface Coal Mine Environmental Registration Document. Prepared by: D. R. Merner Associates Ltd. for Nova Scotia Department of Environment and Labour. January 2000.

Mason, B.J., ed., 1990. The surface acidification programme. Cambridge University Press. 522 p.

McKowan, R. J. 1995. Analysis of Proposed Sand and Gravel Quarry: Granite Fall, WA. September 25, 1995. *In*: Executive Summaries of Studies of Quarry Operations and Impacts on Property Values. Internet Publication http://www.cadman.com/reference/nbgo/studies_of_quarry.html

MGI Limited and ADI Limited (2003). Mine Water Assessment and Monitoring Program. Cape Breton Development Corporation. No. 1B Hydraulic System. Preliminary Report to March 31, 2003. Draft. June 2, 2003. [NSD17024]

MGI Limited, ADI Limited, JWEL and S. Forgeron (2002). Mine Water Assessment and Monitoring Program. Cape Breton Development Corporation. No. 1B Hydraulic System. Preliminary Draft October 30. 2002. [NSD17024]

MGI Limited, Jacques Whitford Environment Limited, and S. Forgeron (2003). Water Balance Assessment report, Cape Breton development Corp. No. 1B Hydraulic System, Glace Bay, Reserve and Dominion, Cape Breton, NS. Prepared for PWGSC. 47 p.

Morris, R., E.W. Taylor, D.J.A. Brown and J.A. Brown, 1989. Acid toxicity and aquatic animals. Society for Experimental Biology Seminar Series, v. 34, Cambridge University Press, 282 p.

National Energy Board (NEB) and CEA Agency. 1996. Report on the Joint Review Panel for the Express Pipeline Project.

Nichols, L.E. and F.J. Bulow, 1973. Effects of acid mine drainage on the stream ecosystem of the East Fork of the Obey River, Tennessee. J. Tenn. Acad. Sci., v. 48, pp. 30-39.

Nova Scotia Department of Energy 2001. Nova Scotia's Energy Strategy.

NSDEL. 1965 - 2005. Pumping Test Inventory. Open File Reports 1965-2005.

NSDNR (Department of Natural Resources). 2005. Mineral Resource Development Regulatory Process. Presentation at July 12, 2005 Public Meeting.

NSDNR (Department of Natural Resources). 2003a. Call For Proposals For Exploration, Development and Reclamation of Selected Areas of the Sydney Coalfield. Department of Natural Resources.

NSDNR (Nova Scotia Department of Natural Resources). 2003b. Coal Related Sites in Industrial Cape Breton. Nova Scotia Department of Natural Resources

NSDNR 1996. Minerals – A Policy for Nova Scotia 1996.

NSEL 2002. Guide to Preparing an EA Registration Document for Mining Developments in Nova Scotia.

Nova Scotia Museum. 1997. Natural History of Nova Scotia: Theme Regions, Volume II.

Parsons, J.D., 1968. The effects of acid strip-mine effluents on the ecology of a stream. Arch. Hydrobiol., v. 65, pp. 25-50.

Parsons, J.D., 1957. Literature pertaining to formation of acid mine waters and their effects on the chemistry and fauna of streams. Trans. Ill. State Acad. Sci., v. 50, pp. 49-52.

Pioneer Coal Ltd. 2004. Environmental Registration Document for Stellarton Pit Mine Extension. Prepared by: MGI Limited for Nova Scotia Department of Environment and Labour. January 2004.

Pioneer Coal Ltd. 2005. Environmental Assessment Registration Document for Surface Coal Mine and Reclamation Project – Prince Mine Site. Prepared by: MGI Limited for Nova Scotia Environment and Labour. June 2005.

Potts, W.T.W. and P.G. McWilliams, 1989. The effects of hydrogen and aluminum ions on fish gills. In: Acid toxicity and aquatic animals. Society for Experimental Biology Seminar Series, v. 34. (R. Morris, et al., eds.). Cambridge University Press, pp. 201-220.

Roback, S.S. and J.W. Richardson, 1969. The effects of acid mine drainage on aquatic insects. Proc. Acad. Nat. Sci. Phil., v. 121, pp. 81-107.

Robertson, Davis S. and Associates Ltd. 1975. Assessment of Coal Reserves for Strip Mining at Point Aconi, Cape Breton Island. NS Dept. of Mines and Energy Open File Report 353.

Rosemond, A.D., S.R. Reice, J.W. Elwood and P.J. Mulholland, 1992. The effects of stream acidity on benthic invertebrate communities in the south-eastern United States. Freshwater Ecol., v. 27, pp. 193-209.

Shawinigan Engineering Ltd. 1980. Groundwater Protection Guidelines in Nova Scotia. Report to NSDOE. 206 p.

Statistics Canada. 2001. 2001 Community Profiles – Community Highlights for Cape Breton Regional Municipality. Internet Publication. http://www.statscan.ca.

Stea, R., H. Conley and Y. Brown (1992). Surficial Geology of the Province of Nova Scotia. Nova Scotia Dept. of Natural Resources, Map 92-93.

Thomas Brogan and Sons Construction Limited. 2004. Environmental Registration for Point Aconi Phase – 3 Surface Coal Mine. Prepared by: SGE Acres Limited for Nova Scotia Environment and Labour. December 2004.

Warner, R.W., 1971. Distribution of biota in a stream polluted by acid mine-drainage. Ohio J. Sci., v. 71, pp. 202-215.

Weed, C.E. and C.W. Rutschky, 1971. Benthic macroinvertebrate community structure in a stream receiving acid mine drainage. Proc. Pa. Acad. Sci., v. 50, pp. 41-46.

7.2 References for Best Management Practices

Acid Drainage Technology Initiative, "Prediction of Water Quality at Surface Coal Mines", published by the West Virginia Water Research Institute.
http://wvwri.nrcce.wvu.edu/programs/adti/pdf/adti_predictions.pdf

Colorado Mined Land Division, "Guidelines for Baseline Water Quality and Overburden Geochemistry Data". http://mining.state.co.us/Forms/OverburdenBaseline.pdf

Office of Technology Transfer, "A Manual for Training Reclamation Inspectors in the Fundamentals of Soils and Revegetation", Office of Surface Mining. http://www.ott.wrcc.osmre.gov/library/hbmanual/mtri.htm

U.S. Office of Surface Mining. "Permitting Hydrology. A Technical Reference Document for Determination of Probable Hydrologic Consequences (PHC) and Cumulative Hydrologic Impact Assessments (CHIA)". http://www.osmre.gov/pdf/phcchiareport.pdf

U.S. Office of Surface Mining, "Handbook of Western Reclamation Techniques". http://www.ott.wrcc.osmre.gov/library/hbmanual/westrecl/handbook.pdf

US Code of Federal Regulations 30 CFR Title 30--Mineral Resources Part 700 to end, "Chapter VII – Office of Surface Mining Reclamation and Enforcement, Department of Interior". http://www.access.gpo.gov/nara/cfr/waisidx_04/30cfrv3_04.html

---

7.3 Personal Communication

Brown, B. Fisheries and Ocean Canada (DFO). July 2005.

House, L. Zone director, ATV Association of NS. July 20, 2005.

G. Lee. Nova Scotia Transportation and Public Works, September 9, 2005.

MacDonald, S. General Manager, Destination Cape Breton. July 26, 2005

Meloney, B. Chair, Sydney Area Business Association. July 20, 2005

Power, T. DFO. July 2005.

Spicer, B. Development Officer, Cape Breton Regional Municipality. June 30, 2005.

Stone, Kevin. Natural Resources Canada. July 2005.

Whally, J. Economic Development Officer. Cape Breton Regional Municipality. July 15, 2005

APPENDIX A

Aerial Photos of Coal Resource Blocks
Courtesy of NSDNR

Figure 1 Point Aconi

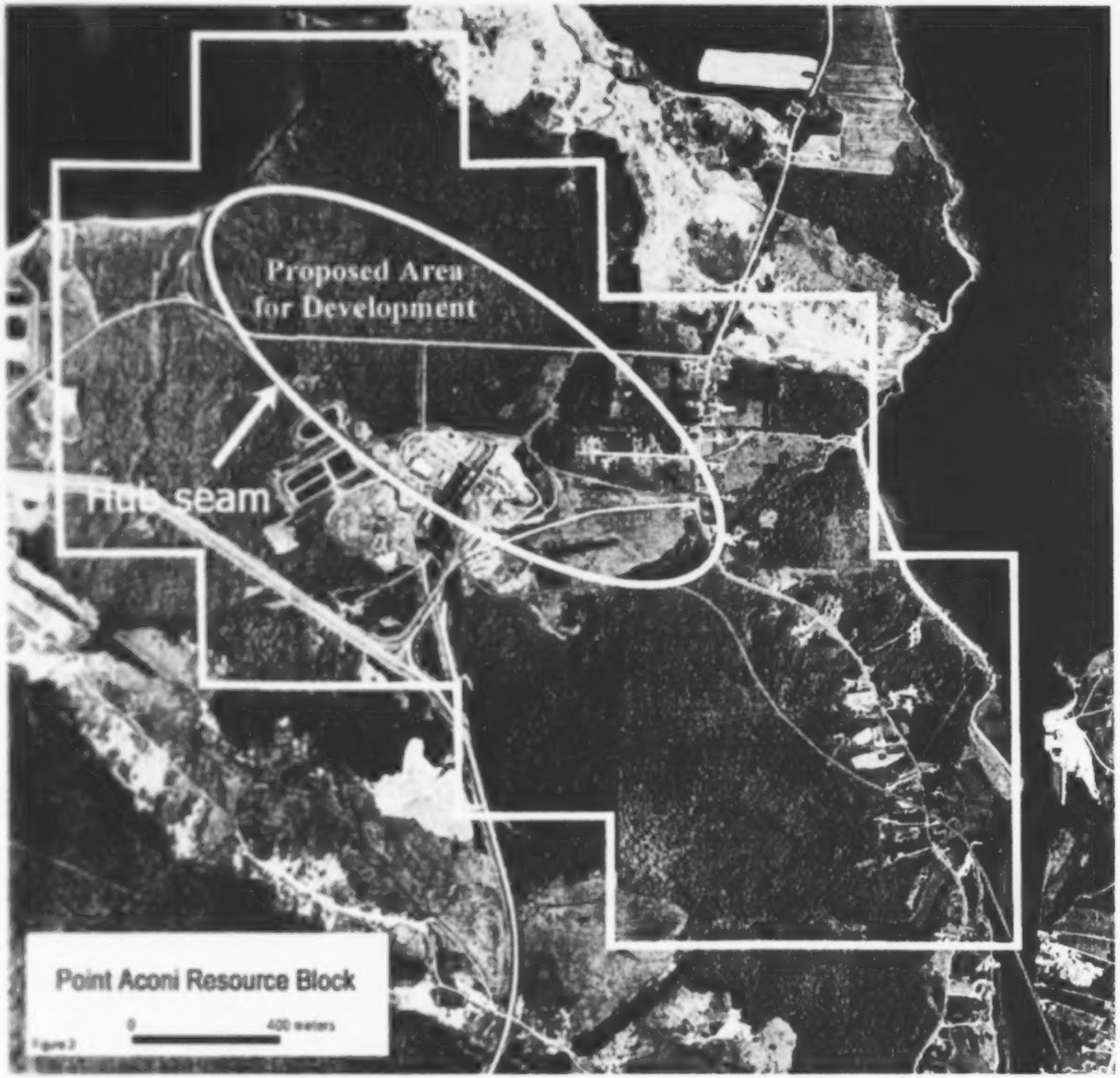

Proposed Area
for Development
Hub seam
Point Aconi Resource Block
0
400 meters
Figure 2

Figure 2 Boularderie Island

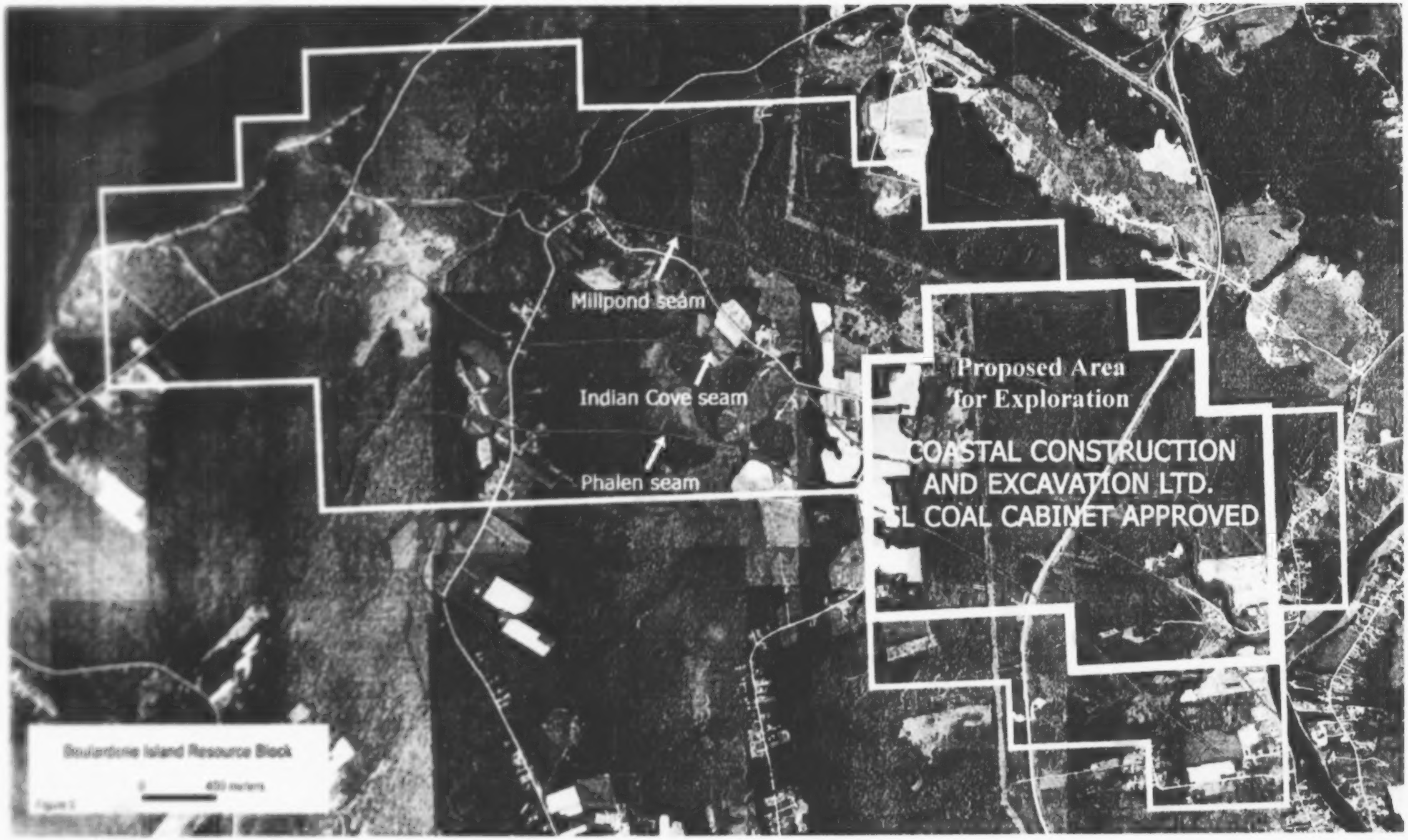

Millpond seam
Indian Cove seam
Phalen seam
Proposed Area
for Exploration
COASTAL CONSTRUCTION
AND EXCAVATION LTD.
SL COAL CABINET APPROVED
Boulardrie Island Resource Block
0
400 meters
Figure 2

Figure 1 Point Aconi

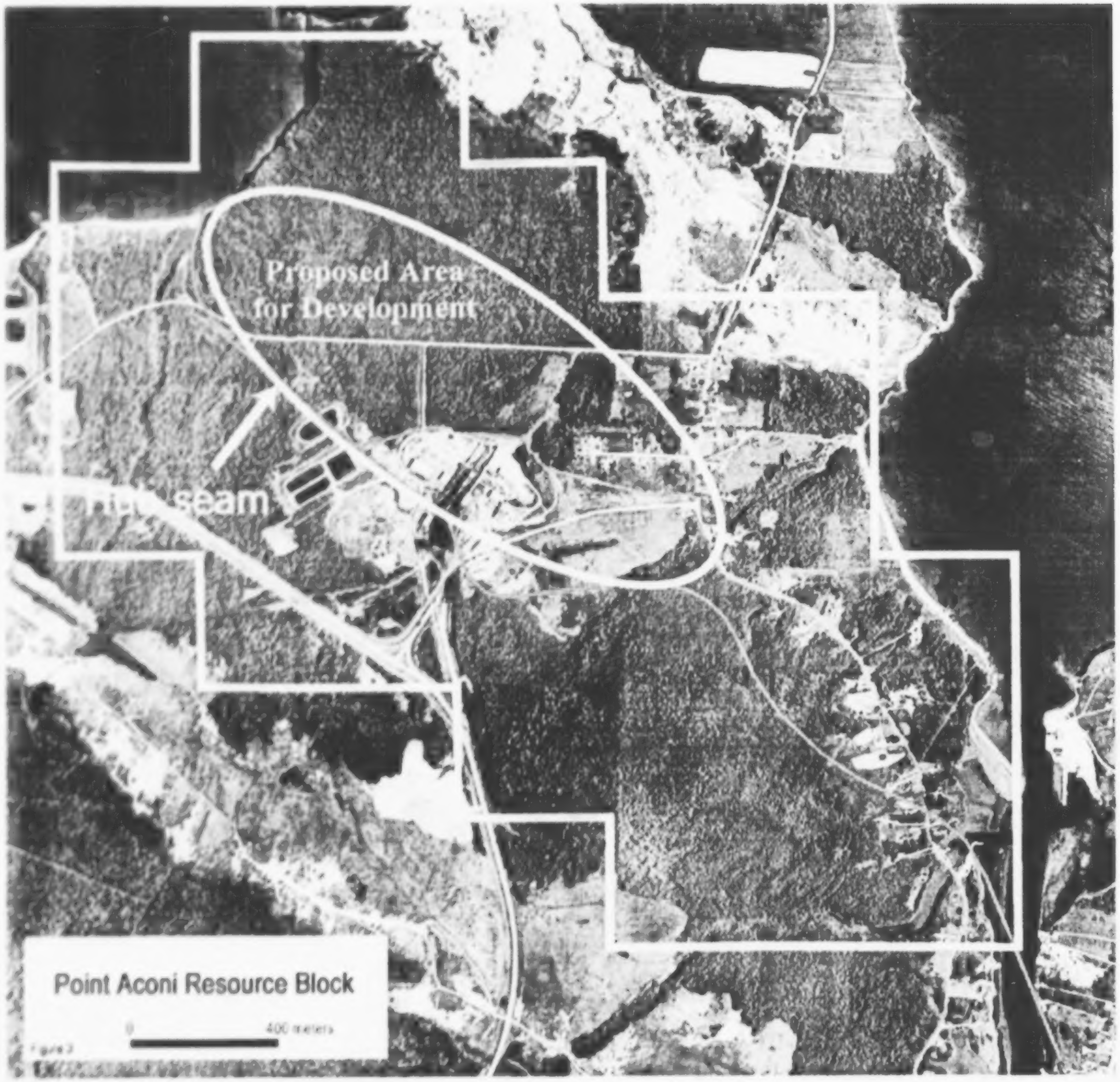

Proposed Area
for Development
seam
Point Aconi Resource Block
0
400 meters

Figure 2 Boularderie Island

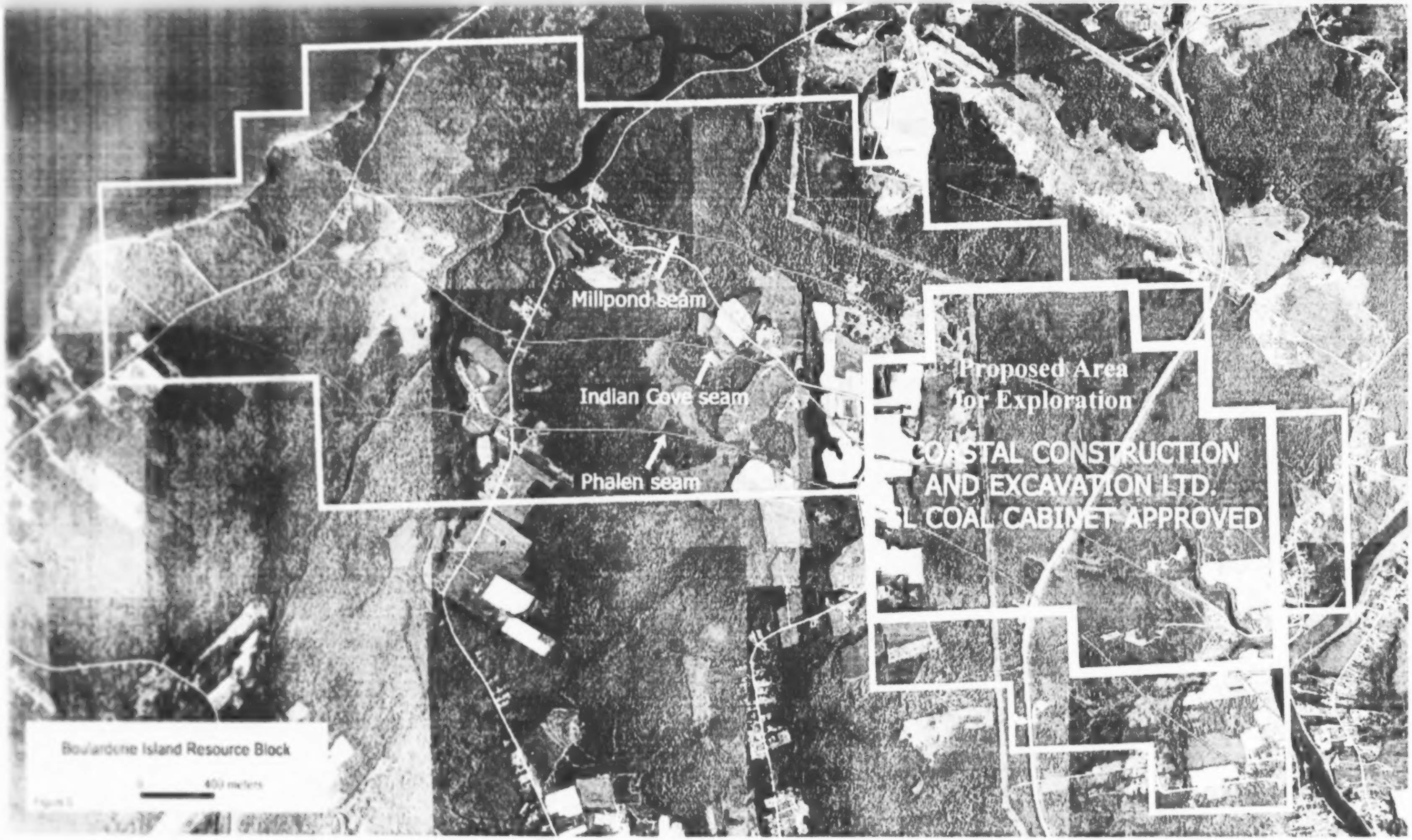

Millpond seam
Indian Cove seam
Phalen seam
Proposed Area
for Exploration
COASTAL CONSTRUCTION
AND EXCAVATION LTD.
L COAL CABINET APPROVED
Boularderie Island Resource Block
0
400 meters
Figure 5

Figure 3 Birch Grove

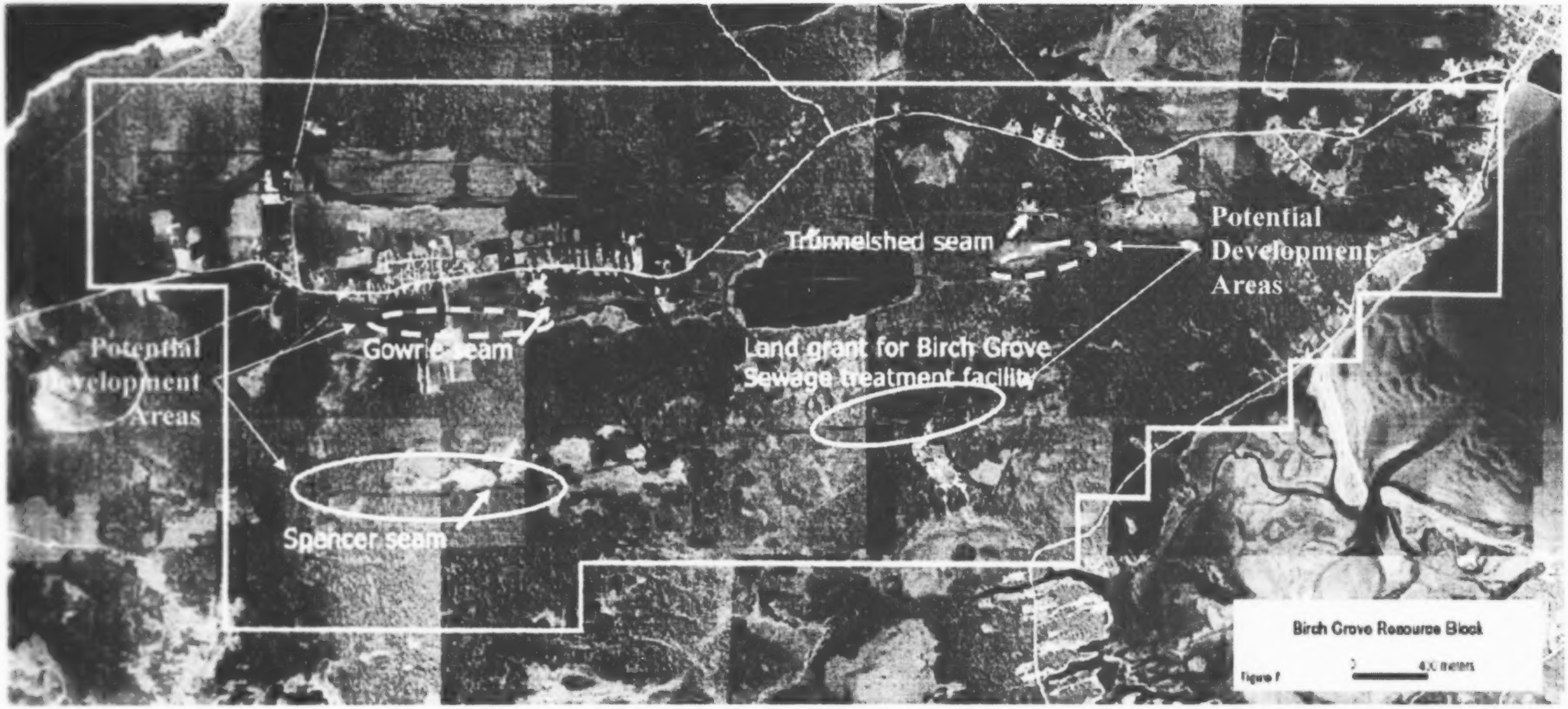
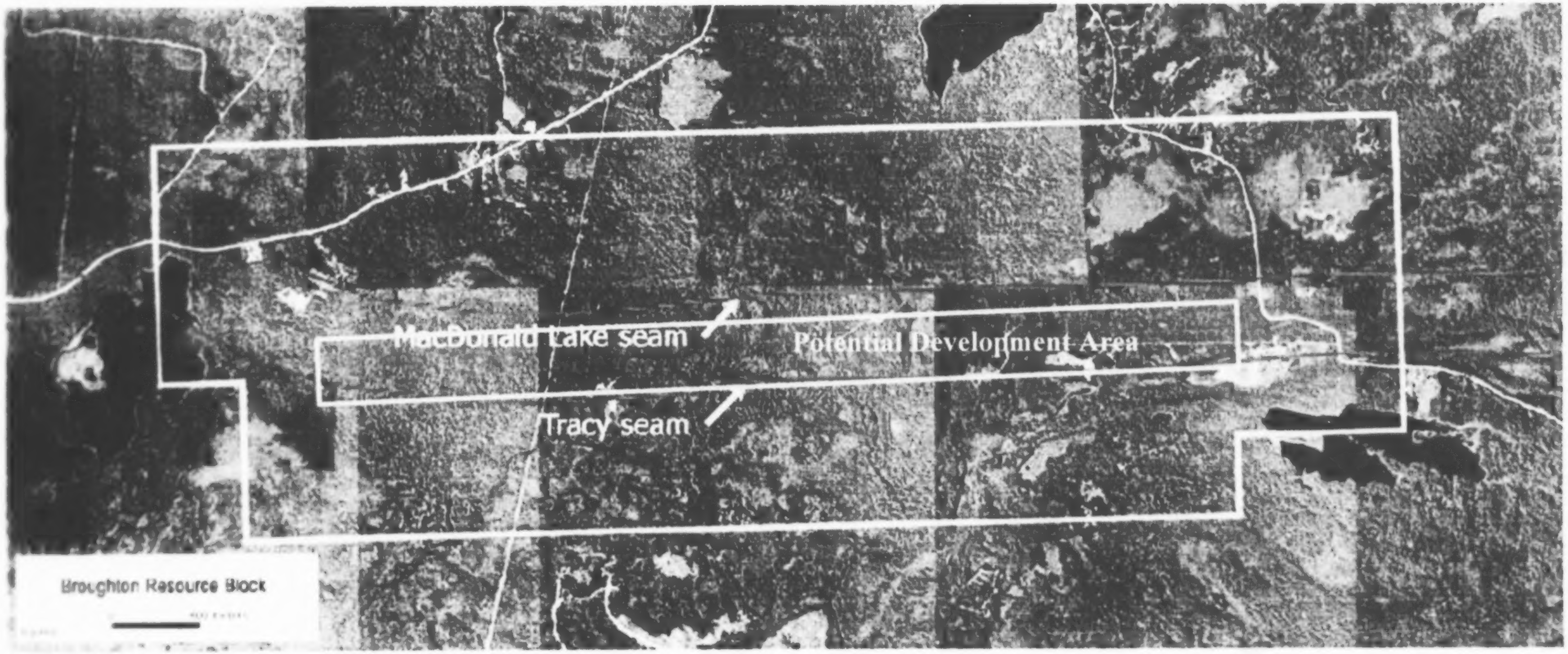
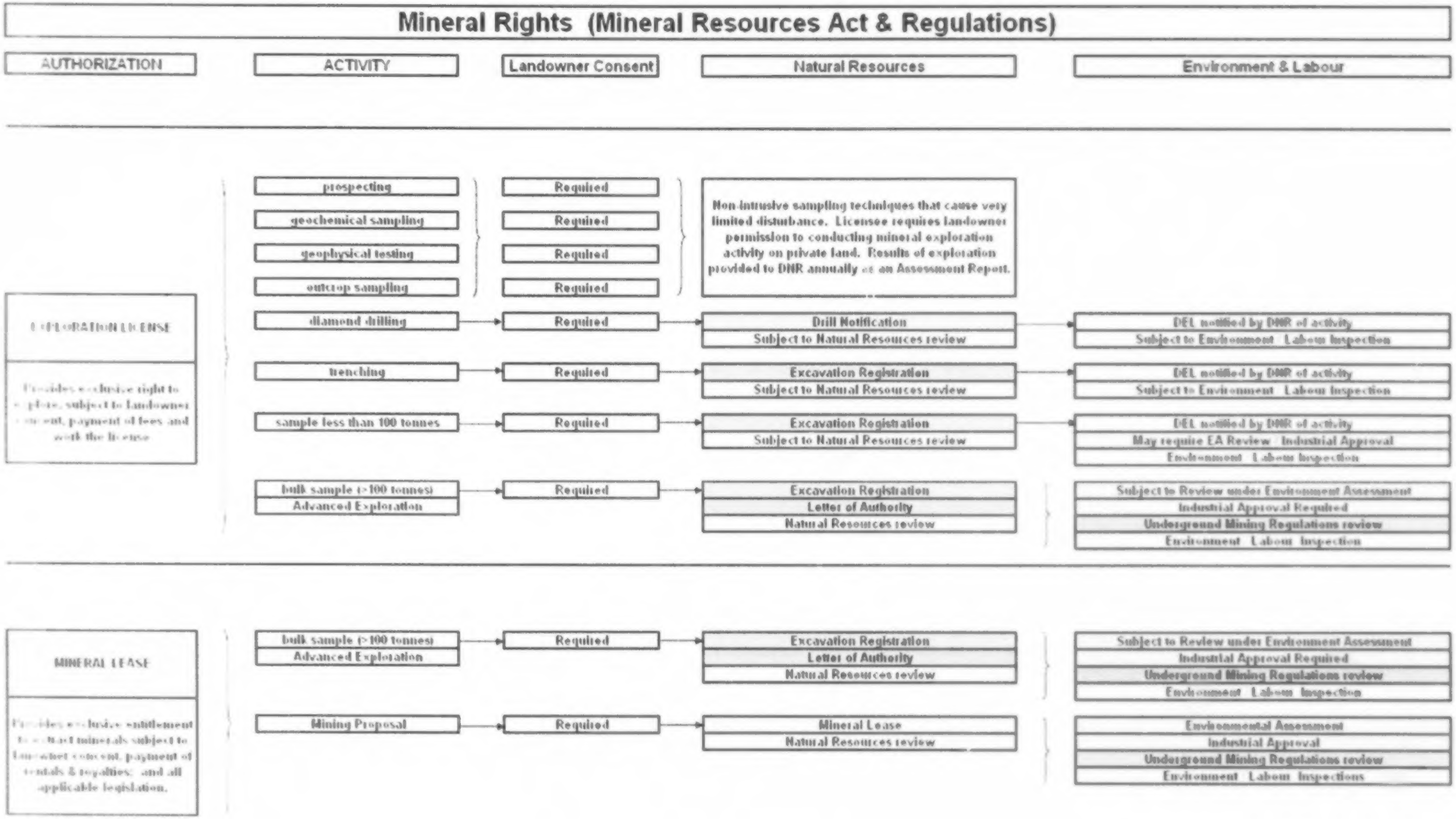

Potential
Development
Areas
Trunnelshed seam
Gowrie seam
Land grant for Birch Grove
Sewage treatment facility
Spencer seam
Potential
Development
Areas
Birch Grove Resource Block
Figure 7
0
400 meters

Figure 4 Broughton


MacDonald Lake seam
Potential Development Area
Tracy seam
Broughton Resource Block

APPENDIX B

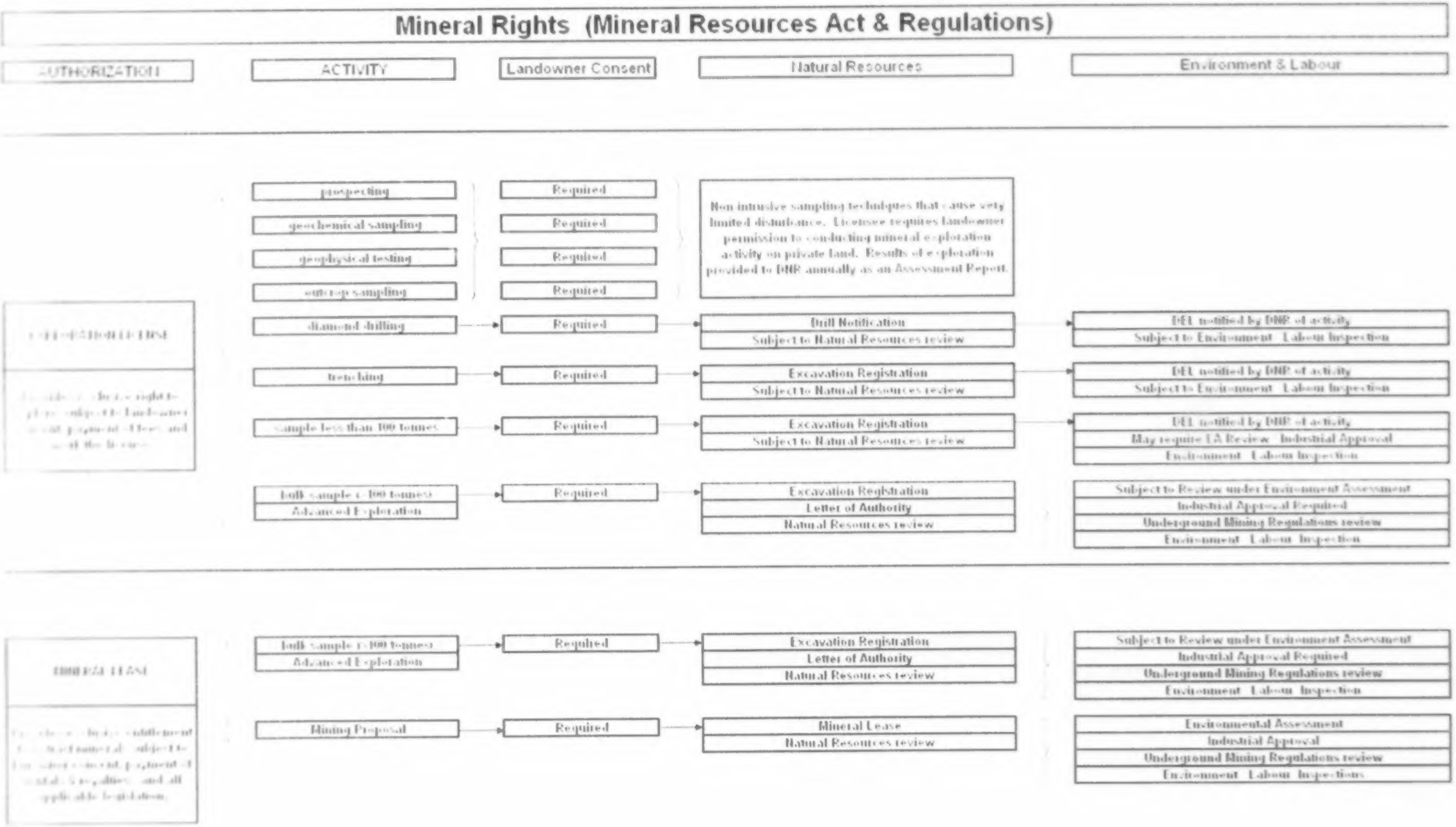
Regulatory Process for Mine Exploration and Development
Courtesy of NSDNR



Mineral Rights (Mineral Resources Act & Regulations)

AUTHORIZATION	ACTIVITY	Landowner Consent	Natural Resources	Environment & Labour
EXPLORATION LICENSE Provides exclusive right to explore, subject to landowner consent, payment of fees and work the license	prospecting	Required	Non-intrusive sampling techniques that cause very limited disturbance. Licensee requires landowner permission to conducting mineral exploration activity on private land. Results of exploration provided to DNR annually as an Assessment Report.	
	geochemical sampling	Required		
	geophysical testing	Required		
	outcrop sampling	Required		
	diamond drilling	Required	Drill Notification Subject to Natural Resources review	DEL notified by DNR of activity Subject to Environment Labour Inspection
	trenching	Required	Excavation Registration Subject to Natural Resources review	DEL notified by DNR of activity Subject to Environment Labour Inspection
	sample less than 100 tonnes	Required	Excavation Registration Subject to Natural Resources review	DEL notified by DNR of activity May require EA Review Industrial Approval Environment Labour Inspection
	bulk sample (>100 tonnes) Advanced Exploration	Required	Excavation Registration Letter of Authority Natural Resources review	Subject to Review under Environment Assessment Industrial Approval Required Underground Mining Regulations review Environment Labour Inspection
MINERAL LEASE Provides exclusive entitlement to extract minerals subject to landowner consent, payment of rentals & royalties; and all applicable legislation.	bulk sample (>100 tonnes) Advanced Exploration	Required	Excavation Registration Letter of Authority Natural Resources review	Subject to Review under Environment Assessment Industrial Approval Required Underground Mining Regulations review Environment Labour Inspection
	Mining Proposal	Required	Mineral Lease Natural Resources review	Environmental Assessment Industrial Approval Underground Mining Regulations review Environment Labour Inspections

Mineral Rights (Mineral Resources Act & Regulations)



AUTHORIZATION	ACTIVITY	Landowner Consent	Natural Resources	Environment & Labour
EXPLORATION LICENSE [illegible] exclusive right to explore subject to Landowner consent, payment of fees and work on the license	prospecting	Required	Non intrusive sampling techniques that cause very limited disturbance. Licensee requires Landowner permission to conducting mineral exploration activity on private land. Results of exploration provided to DNR annually as an Assessment Report.	
	geochemical sampling	Required		
	geophysical testing	Required		
	outcrop sampling	Required		
	diamond drilling	Required	Drill Notification Subject to Natural Resources review	DEL notified by DNR of activity Subject to Environment Labour Inspection
	trenching	Required	Excavation Registration Subject to Natural Resources review	DEL notified by DNR of activity Subject to Environment Labour Inspection
	sample less than 100 tonnes	Required	Excavation Registration Subject to Natural Resources review	DEL notified by DNR of activity May require EA Review Industrial Approval Environment Labour Inspection
	bulk sample (> 100 tonnes) Advanced Exploration	Required	Excavation Registration Letter of Authority Natural Resources review	Subject to Review under Environment Assessment Industrial Approval Required Underground Mining Regulations review Environment Labour Inspection
MINERAL LEASE [illegible] exclusive right to [illegible] establishment [illegible] minerals subject to Landowner consent, payment of rentals, royalties, and all applicable legislation.	bulk sample (> 100 tonnes) Advanced Exploration	Required	Excavation Registration Letter of Authority Natural Resources review	Subject to Review under Environment Assessment Industrial Approval Required Underground Mining Regulations review Environment Labour Inspection
	Mining Proposal	Required	Mineral Lease Natural Resources review	Environmental Assessment Industrial Approval Underground Mining Regulations review Environment Labour Inspections

APPENDIX C

List of Contacts

Appendix C
Consultation Contacts

CBRM	John Morgan, Mayor John Whalley, Economic Development Officer Mike MacKeigan, Manager of Utilities Administration Doug Foster, Director of Planning Cllr. Wes Stubbert, District 16 Cllr. Kevin Saccary
Other elected representatives	Gerald Sampson MLA, Big Bras D'Or
CASM, Boularderie	Keith Boutilier Don Blair Earl Cantwell Wilf Isaac David MacDonald Russell MacDonald Karen MacPhee Allan Nicholson Donna Stubbert
CASM, Port Morien	Wilfred Campbell Jim Fraser Ken MacDonald Donald MacLeod Laird (Bucky) MacLeod Neil MacAulay Byron Peach Leroy Peach Ron Peach Winnie Peach Sheldon Smith Allister Spencer
Other Organizations	Jackie Allen, Fisherman Pat Bates, Bras D'Or Lakes Stewardship Society, resident Sydney Mines Chris Eyking, Bras d'Or Producers Cooperative Paul MacDougall, Halfway Road Committee Judy MacMillan, ACAP
Federal Government	Bruce Clyburn, Cape Breton Development Corporation Richard Crowe, Public Works

Provincial Government	Don Jones, NSDNR Diane LaRue, restoration ecologist NSTPW Lawrence MacDonald, NSEL Dennis Merner, NSEL Tom Soehl, NS Aboriginal Affairs Peter Weaver, NSEL
Industry	Ed Carey, Carey Geotechnical Engineering (Coastal Construction) Peter Oram, MGI (Pioneer Coal)
First Nations	Dan Christmas, Membertou Band Council Roger Hunka, Native Council of Nova Scotia
Letters sent to	Five Cape Breton First Nations Union of Nova Scotia Indians Confederacy of Mainland Mi'kmaq Unamaki Institute Native Council of Nova Scotia

APPENDIX D

Supplemental Information from Community Consultation

Appendix D

Supplemental Information From Community Consultation

This appendix provides summary information on each of the main surface coal mining related sites (including old, active and proposed sites). Notes on the community perspective have been drawn from stakeholder interviews and presentations.

1. Brogan Mining, Point Aconi

Brogan Mining carried out surface coal mining operations on this site from 1977 to 1993, producing a total of 636,000 tonnes. The land is owned by Brogan Mining and by other private owners.

Brogan Mining was not allowed to excavate over the Prince Mine slopes while the mine was active. Subsequently, in December 2004, Thomas Brogan and Sons applied to remove a further 50,000 tonnes from this area. The Minister of Environment and Labour concluded in January 2005 that the Environment Assessment Registration Document did not contain sufficient information.

DNR considers that the older part of the site has now been remediated, and the reclamation bond has been released.

Community members feel strongly that the reclamation is inadequate, even though most of the area is now revegetated. Fisher also reported that the mining had caused significant siltation over productive lobster grounds in that area.

2. Prince Mine Site, Point Aconi: Proposed Surface Coal Mining and Reclamation Project

Pioneer Coal Limited was awarded exclusive rights to apply for a Special Mining Lease in the Point Aconi Coal Resource Block in January 2005, and has subsequently registered an undertaking for environmental assessment approval to mine approximately 350,000 tonnes of coal annually for seven years. Pioneer proposes to use both conventional surface coal mining techniques and highwall mining techniques.

The land is currently owned by Cape Breton Development Corporation who operated the Prince Mine between 1975 and 2001. The site includes surface infrastructure, settling ponds and ARD treatment facility, and 5.7 acres of waste piles from the underground operation. The site also has a very high concentration of bootleg pits along the Hub Seam outcrop.

The project as proposed would reclaim the bootlegged area first and would also remove and incorporate the Prince Mine waste rock pile.

In June 2005, the Minister of Environment and Labour requested additional information from Pioneer in order to complete the Environmental Assessment of the Prince Mine Site project.

Many individuals and organizations are energetically opposing the proposed project. Issues raised include concerns about:

- effects of drawdown, blasting and potential contamination on groundwater ;
- effects on local farming and fishing operations;

- visual impacts and consequent effects on tourism;
- impacts on surface water quality and on wildlife habitat; and
- long term reclamation prospects.

Residents also refute the need for remediation of hazardous areas, maintaining that this is only being used as an excuse to justify more strip mining. They have stated that if the area is indeed hazardous, it should be CBDC's responsibility to take action to remediate it.

3. Novaco, Point Aconi

This surface coal mining operation took place on Provincial Crown land in 1979-85, and was carried out by Pioneer Coal on behalf of Novaco, a provincial Crown corporation. The total production was 794,000 tonnes.

Reclamation was completed in 1992. From DNR's perspective, the site is now well vegetated. The reclamation included tree planting but many of the trees were subsequently illegally removed. Complaints have been received about the use of tamarack, but DNR is confident that these will be gradually replaced through natural regeneration. From the operator's perspective, Pioneer carried out the reclamation according to Provincial specifications. The land was contoured but no soil amendments were added.

Community stakeholders have many complaints about this site however. They maintain that while the site looks green from the road, the surface is pitted and uneven, there is little topsoil left and vegetative growth is not sustainable. The trees have not grown well; by contrast some of the "removed" trees planted in other locations show much better growth. Residents close to the Novaco site also reported experiencing noise, blasting, impacts on local wells and unannounced road closures.

4. Cape Breton Development Company, Alder Point

This was one of the earliest surface coal mines, operated in 1973-75 to provide an emergency supply of coal to Nova Scotia Power because of a coal supply shortage. The mine was operated by LaVatte Construction for CBDC, and produced a total of 89,000 tonnes. The land is in a mixture of Crown and private ownership. DNR considers the site to be fully reclaimed with extensive tree growth.

5. Cape Crushing, Alder Point

Cape Crushing is currently actively mining this site at Alder Point and has been producing about 8-10,000 tonnes of coal a year, which is being sold to Devco to meet their commitments to provide low-cost coal to Devco pensioners.

6. Little Pond

Two collieries operated in the Little Pond area, followed, in the 1940's and 50's by an early surface coal mine operated by Mills Mining.

Between 1998 and 2005 Thomas and Richard Brogan operated a surface mining operation in the South and Central divisions of this area, which is partly provincial Crown land and partly owned privately. Mining activity has produced a total of 40,000 tonnes.

Originally, with DNR approval, the operator had also planned to mine the North division of the Little Pond site, otherwise known as Merritt Point. However, they began excavation before receiving required permits from NSEL and the work was eventually stopped and the operator fined under the terms of the Environment Act. They are also now required to reclaim this area under a court order and have recently started to dewater the pit.

Reclamation in the South and Central portions of the site is underway.

From the community perspective, this site is highly contentious and is seen as an example of surface coal mining at its worst. A large area of land, including scenic coastline, was seen as being blighted during operations and the subsequent reclamation attempts are viewed as completely inadequate — "a wasteland and an eyesore". Residents believe that Smelt Brook was severely damaged during this process and surface drainage around local homes was disrupted, causing flooding and killing trees. Residents are incensed that the illegal mining at Merritt Point could have gone on so long before the government took action. Residents also complain of inadequate government monitoring and enforcement, and cite as an example the release of acidic water from the site into the sea when the operator dug a ditch from two small holding ponds to the edge of the cliff. Residents documented this occurrence and Fisheries and Oceans Canada eventually sent staff to investigate but did not take action against the operator.

Other complaints included noise from a dragline that operated 24 hours a day in violation of a permit requirement, and difficulties getting any action from the operator when nearby residents lost their wells.

Aerial view of Little Pond being mined

Area recently hydro-seeded (Photo. D. Rushton)

---

7. Toronto Road

Brogan Mining operated the Toronto Road surface coal mine from 1994-98, removing 99,000 tonnes of coal. The operator originally talked about creating a golf course on this site but this has not proceeded. The area was reclaimed and DNR released most of the reclamation bond in 2000, but is reassessing the status of the reclamation.

As with other reclaimed sites in the area, residents dispute the effectiveness of the reclamation.

8. Sullivans Creek

Brogan Mining removed 98,000 tonnes from the Sullivans Creek site from 1993-97. According to DNR, this area was originally scarred by many sinkholes caused by earlier underground workings that were filled with garbage . The pond was also being affected by ARD. Local residents asked the operator to mine out the area to make the land safer and more usable. The mining activity came very close to the houses. This site is seen by DNR as a good example of the benefits of reclamation mining and also of the ability of sites to recover.

9. Tobin Road/Halfway Road

The Tobin Road/Halfway Road site was the location of extensive underground mining. Eight collieries were located within the boundary of the current parcel of Provincial Crown land, and a further three collieries were located on adjacent land. The site has also been extensively bootlegged; over 200 abandoned illegal mine openings have been documented. Underground mining finished in 1963 and the site is largely reforested through natural regeneration.

The potential near-surface coal resource is estimated at 100,000 tonnes. Cape Crushing received approval to conduct two 5,000 tonne bulk samples in 2003. T. Brogan and Sons carried out the work on behalf of Cape Crushing. When it became obvious that the coal at the first bulk sample site on the Stony seam had been largely mined out the balance of the 5,000 tonnes was reallocated to the second site on the Collins seam. The bulk sample activity remediated some of the hazardous old mine openings and under workings.

Reclamation has not been completed on these sites. Some of the topsoil was spread and the areas seeded earlier this year but almost no growth has occurred. The current plan is to re-seed the site.

Unused topsoil pile (Photo: D. Rushton)

Area six weeks after seeding (Photo: D. Rushton)

DNR supports the concept of surface coal mining on this site, in part in order to remove the hazardous old workings.

From the community perspective, this is a highly contentious potential project. A small, informal group of residents, originally opposed to surface coal mining plans in this area, is now promoting site remediation through surface coal mining. The group is critical of industry practice to date and what they see as a lack of government enforcement. Issues relating to the bulk sample sites at Tobin Road/Halfway Road include the way the access road was developed and the lack of effective remediation. But the group has also been working with DNR on developing future land use concepts for the area, which could include reclaiming areas of land for community use, reconfiguring the boundaries of a scrapyard that has encroached on Crown land, developing a central pond/wetland system, intercepting ARD from the adjacent old Tom Pit Mine and redirecting it to an engineered wetland. These concepts would require the development of partnerships and the infusion of additional resources, over and above DNR's usual reclamation requirements.

10. Greenhills, Proposed Surface Coal Mining Project, Florence

A small surface coal mining project is proposed in Florence, on private land (several owners, but mostly in one family) that was the location of the old Florence Colliery, active between 1901 and 1961.There are extensive under workings in this area but little bootleg activity.

In 2000, the King family registered a project proposal to remove coal (mainly crown pillar removal) from the Harbour Seam. The project was released from environmental assessment in the same year but the project was delayed by the need to secure markets. An application for an Industrial Activity permit has now been received by NSEL. The original time frame was 18 months, but the current plan is to mine approximately 30,000 tonnes of coal annually for four years.

The proposed project is limited in scope. A total of 28 acres would be disturbed, excavated to a maximum depth of 60 feet, mining would be seasonal, and no blasting would be involved.

The proponent indicated that they have secured the support of the local community through public and individual meetings, and the creation of a community liaison committee. Feedback received during the study, however, indicated that at least some people in Florence were unaware that the project had passed through environmental assessment, did not know what was being proposed and had significant concerns.

11. Gardiner East, Reserve Mines

The surface coal mine at Gardiner East, near the community of Reserve Mines, was operated between 1986 and 1992 by Pioneer Coal who owns the site. They produced 709,000 tonnes from the Gardiner and O'Dell seams. This large site was re-contoured, leaving a lake in the centre, and efforts have been made to establish a vegetation cover. After seeding, grass grew well for about five years and then suffered a significant setback. Plant growth is now somewhat patchy but there is significant shrub growth and some trees.

The water in the lake on the site is highly acidic (likely around 4.5 to 5.0 pH) but this is consistent with other natural lakes in area. Surface drainage towards the lake appears to be dropping iron precipitate around its margin. Pioneer returned to the site in 2004 and added straw mulch and seeds to this area, with limited success.

Vegetation thirteen years after closure (Photo: D. Rushton)

Wetland on site (Photo: D. Rushton)

However, from a community perspective, some residents see this site as "a complete mess". During the operation of the mine there were complaints about blasting impacts. Residents complained of damaged wells, cracked basements and air concussion impacts. A report commissioned by the provincial government and prepared by Nolan Davis questioned these claims on the grounds that the geological structures in the area could not have transmitted blast effects very far from the mine site.

Residents also believe that proper reclamation has not taken place, and that the site will neither regain productive ecological status nor be useful for residential/commercial development, especially as the government no longer holds a reclamation bond. There is cynicism about Pioneer's recent efforts to address local ARD, which have been interpreted as a public relations measure to support Pioneer's other surface coal mining proposals.

12. Broughton Bulk Sample Site

In 1999 H.W. Phillips and Sons Construction Ltd. carried out a bulk sample operation in the Broughton area on Federal Crown land that was the location of the Four Star and Beaver underground mines. These mines have produced and continue to produce significant quantities of ARD that is affecting local wetlands and surface water.

Reclamation of the bulk sample site has not been completed and the pit was left open for a number of years. The operator was allowed to delay reclamation because they indicated that they still had plans to file a proposal for a surface coal mine in this area. A reclamation plan was finally filed in the summer of 2005 and the operator has just begun to fill in the pit.

From a community perspective, this situation was seen as being completely unacceptable. The pit was viewed as a considerable hazard, and there are concerns that acidic water in pit has migrated into the groundwater, and that contaminated water in a holding pond has flowed into a nearby wetland and beyond.

APPENDIX E

Vegetation Assessment of Surface Coal Mine Reclamation Sites

Vegetation Assessment on Surface Mining Reclamation Sites

Introduction

In the past, land reclamation associated with surface mining in Nova Scotia could probably best be described as the reconditioning of the land to a state fit for some future use. It included the stabilization, contouring and revegetation of the surface of land.

Twenty years ago, reclamation dealt primarily with the elimination of site risk and placed less emphasis on future land use. Involvement of local community groups in decision making for what future land uses might include was not a common practice. Over the last ten or so years, it would appear that mining contractors have tried to meet the needs and interests of local communities by including such things as recreational parks, ball fields and water features (*i.e.*, wetlands) in the final land reclamation plan.

However, the shear number of reclaimed sites near some communities, and in the eyes of many local residents, the failure of these sites to return to a self-sustaining and diverse local ecosystem, has resulted in those same residents being skeptical of more surface mining operations in their community. These citizens point to some poorly reclaimed mine lands already in their community, as an example. This is not to say that mining contractors have not been trying to provide safe, stable, and re-vegetated landscapes in their reclamation efforts. It would appear, however, that the time has come where local residents are now going to demand that self-sustaining ecological restoration principles be incorporated in future reclamation planning and practices. This means that land reclamation will need to include the application of diverse ecological restoration principles that embrace the succession of mine land back to its original function and structure.

Reconnaissance Survey and Observations

On July 24 and 25, 2005, representatives of the study team (with reclamation expertise) took part in a reconnaissance survey of approximately 12 mine sites in the areas of Stelleraton/Westville and Sydney/North Sydney. The reclamation effort at these sites varied from those that had been reclaimed some twenty years ago to those sites presently in the early stages of reclamation. The purpose of this exercise was to provide a "snap shot in time" commentary on the overall success of reclamation work carried out in terms of site revegetation. The following is a brief synopsis of observations made over the course of the survey:

- Most sites were devoid of trees and to the observer appeared to be destined to a grassland existence.
- While most sites appeared to be stable and free of erosion, the vegetative cover varied between adequate to marginal.
- At some sites the vegetation had actually regressed after 5 to 7 years of "fairly good" growth.
- Reclamation projects carried out over the last few years usually included a water feature, with pond(s) and/or wetland(s) incorporated into the final landscape. The water features viewed during the reconnaissance are a positive addition and enhance the diversity of vegetation at these sites.
- Stockpiles of overburden were observed at active reclamation sites but it appeared that most of these stockpiles have existed for some period of time. This will significantly decrease the ability of those soils to provide native root or seed stock.
- The top layer of mine soil at many active reclamation sites appeared to be exceedingly compacted. This will significantly decrease the ability of those areas to regenerate native trees and shrubs.
- It was evident during these site visits that there was no real yardstick to measure success at these sites at varying stages of reclamation.

- Revegetation goals at these sites did not appear to be clearly defined or clearly understood by everyone involved and/or perhaps did not go far enough. It does not appear that ecological considerations to ensure self-sustaining vegetation have been thoroughly considered on these projects.
- The overriding goal at these sites appears to be their return to a grassland state. In Nova Scotia, after mining and reclamation, the land, given enough time, will return to its original function and structure through a process called forest succession. Are current reclamation measures in fact inhibiting this natural succession?

Best Practice Elements

The following are a number of best practice elements that should be considered in future strip mining reclamation projects:

- Better understanding of the spoil characteristics and mine soil properties through sampling and analyzing of results (*i.e.*, pH, soluble salts, and soil fertility). Trees, for example, can not survive in areas of high soluble salts. Trees will tolerate low pH soils better than grasses. Soil deposits with high soluble salts tend to be sparsely vegetated. The site may have to be limed.
- Wherever possible, separate the true topsoil from underlying layers of soil and rock during the grubbing operation, and spread the topsoil immediately over recently backfilled areas or properly store to maintain the aerobic microbial properties of the soil.
- Stockpiles of topsoil to be left in place for more than two months should be vegetated.
- Determine early on in the reclamation process whether topsoil substitutes are required from deeper soils when there is insufficient natural topsoil present and stockpile this material separately.
- True topsoil and topsoil substitutes should be mixed together during final grading of the site to ensure inoculation of topsoil substitutes with soil microbes and the slow release of nitrogen and phosphorous.
- Accurate overburden analysis should be carried out before mining on each major strata. Each overburden sample should be characterized for rock type, texture and thickness. Each ground sample of each strata should be analyzed for pH, acid-base accounting, P, K, Ca, Mg and soluble salts. This testing is critical as it will determine what strata is best suited to be mixed with topsoil to provide the top lift of mine soil, essential for revegetation of the site.
- The final lift of mine soil should be end dumped and not graded until just before seeding. The final mine soil lift should be in the order of 1 metre in depth and be placed with a dozer to avoid excessive compaction allowing deeper rooted species of shrubs and trees to survive.
- Seeding should be carried out immediately after the grading of final lift of mine soil.
- Time seeding between April 30th to June 1st and August 15th to October 15th.
- In Nova Scotia, more emphasis should be placed on returning the land to its original function and structure through forest succession. A combination of grasses, legumes, nurse shrubs and trees from the area should be identified early on in the planning process. Each of the above plant types will serve a specific reclamation role.
- Care should be taken to ensure tree compatible groundcovers.
- With proper long range planning, a forestry company, for example, could arrange with nurseries for seedlings, plant them at the appropriate time, and do conduct follow-up inspections to ensure survival. Approximately 1500 trees per hectare should be established by a combination of planting, seeding and natural invasion. The mining contractor could also deal directly with local nurseries or farmers to provide the seed, bare root stock and tree seedlings for revegetation of sites.

Research

The following research programs would be of immeasurable benefit to promote self-sustaining vegetation on future reclamation projects.

1. Examine a cross section of previously reclaimed sites with an emphasis on determining whether these sites could now be considered self-sustaining and the reasons for their success or failure. Transects would be laid out in the field. Four or five of the most prevalent plant species in that transect would then be identified along with information on soil pH, fertility (N, P, K, Ca, Mg), soluble salts, plant height, density, etc. Transects would be laid out in different areas of the site based on varying plant communities. Yearly monitoring information would be entered into a GIS database mapping application whereby progress on vegetation regeneration is monitored. This information could be used initially to help develop more comprehensive best management practices to ensure self-sustaining vegetation.

   The results of this research (even early on in the process) could provide the foundation for discussions with local citizens concerned with future reclamation projects, or a general symposium on strip mining reclamation for Industrial Cape Breton, and as a training tool for surface mining contractors.

2. A research component should be attached to future reclamation projects whereby an independent agency, would record and track vegetation succession and provide a semi-annual report on the project. Again, the emphasis of this research would be to better understand what management practices optimize self-sustaining vegetation. It might also provide assurance to local communities that their best interests are being addressed and that they are being updated as to its progress on a regular basis.

Rating System for Assessment

Every person that views a reclamation site will almost surely have differing opinions as to the success of the revegetation at any given time in the process. A yardstick needs to be developed that permits the Department of Natural Resources to measure whether a project is indeed on course to be self-sustaining and will meet the intended land use.

For example, in forest succession, a seed mix (comprised of annual and perennial grasses and legumes), nitrogen fixing nurse shrubs and tree seedlings would be introduced to the reclaimed site immediately after final grading of mine soil. Assessment would then be evaluated based on the following expectations.

- During *Year 1*, the annual grasses and legumes should germinate quickly and provide good erosion cover. The objective of this groundcover would be to ensure erosion control on the site. Nurse shrubs would be planted to assist in nitrogen fixing and improving the physical properties of the mine soil. They should also provide food and shelter for wildlife.
- During *Year 2*, the slower growing perennial grasses and legumes should satisfy the groundcover requirements.
- During *Year 3*, the legumes (*i.e.*, birdsfoot trefoil and white clover) should develop into almost a complete cover replacing the grass and filling in under emerging trees.
- During *Year 4* and beyond, these legumes should persist beneath the trees increasing nitrogen levels for several years until the trees eventually shade the legumes out.